











# THE NATIONAL ENCYCLOPEDIA

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# The National Encyclopedia

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## METHOD OF CROSS REFERENCES

*Words in the articles printed in large and small capitals indicate that there is an article on that subject elsewhere in The National Encyclopedia*

# The National Encyclopedia

BARBIZON

B

CHICKASHA

**BARBIZON SCHOOL OF PAINTING**, a group of French landscape painters, who in the early 19th century were attracted by the natural beauties of the region to Barbizon and the nearby villages in the Forest of Fontainebleau. The school was founded between 1825 and 1860, when nearly every French artist of note and many foreign artists found their way to Barbizon.

The acknowledged leader of the movement was THEODORE ROUSSEAU, who combined a scientific instinct in the delineation of his subject with a larger feeling for its whole character and essence. His broad handling reveals a strong feeling for the fundamental qualities of nature. With Rousseau was closely associated JEAN BAPTISTE CAMILLE COROT, who, while one of the least realistic of the school, accented the note by which it is best known: that of seeing everything through and in the light surrounding it. Although he painted his landscapes directly from nature, Corot imparted to them his own lyric mood. He was one of the first to suggest the salient qualities of an object rather than attempt to represent it in detail.

JEAN FRANÇOIS MILLET, the peasant painter of peasants, made the School best known and appreciated. A landscape was to him but a setting for his figures. He painted his peasant men and women as if they had grown out of the French soil which he, as a peasant, understood profoundly and loved almost religiously. He developed a technique which portrayed movement and simplified contour and planes. His brownish monochrome he relieved by patches of strong color of loaded pigment, to unite his figures with the soil on which they toiled and to impart rugged substance. Most notable was his feeling for atmosphere and sunlight, not for realistic effect, but as parts of design, mass and movement. Yet unlike the later Impressionists, Millet's preoccupation was not with these atmospheric effects, but in his own words to depict the "fundamental side of men and things" and the dignity of labor.

Besides Rousseau, Corot and Millet, the inner group of Barbizon painters included Troyon, Diaz, Dupré and Daubigny. Through the Barbizon School the spell of the DÜSSELDORF SCHOOL upon American art standards and artists was permanently broken, largely through the efforts of William Morris Hunt, who induced his countrymen to be among the first to recognize the merits of Millet and the French school.

**BARBOSA, RUY** (1849-1923), Brazilian writer, orator, journalist and jurist, born in Bahia, and educated in the law, graduating in 1871. In the *Jornal do Commercio* he wrote articles under the pseudonym of Lincoln, favoring the abolition of slavery. In the *Daíro de Noticias* he opposed the monarchy and supported the adoption of a federal constitution. In 1889, when the monarchy fell, he became minister of finance and one of the most influential members of the constituent assembly. The present constitution of Brazil, an adaptation of the Federal document of the United States, is largely the work of Barbosa. In 1910 he was the *civilista* or civilian candidate for the Presidency which was won by Hermes, a *militarista*. Before that, in 1907, he called world wide attention to Brazil by his brilliant oratory at the Second Hague Convention, where he espoused the cause of the rights of small nations and the principle of arbitration. He later served as one of the judges of the Permanent Court of Arbitration at The Hague.

**BARBUDA**, an island of the West Indies, one of the British group known as the LEEWARD ISLANDS. It has an area of 68 sq. mi., only a small part of which is under cultivation, though the soil is productive. Corn, tobacco, cotton and sugar are the chief products. Cattle-raising is the major occupation of the natives. Barbuda forms part of the presidency of ANTIGUA; its population is included in that of Antigua, which was 30,909 in 1931.

**BARBUSSE, HENRI** (1874- ), French author and pacifist, was born in Paris, May 17, 1874. He attended the Collège Rollin, and later became editor of the periodical *Je Sais Tout*. In 1917, he won the Goncourt Prize for *Le Feu*, translated as *Under Fire*, the first of the realistic, unromanticized novels of the World War. Among Barbusse's other works are *Clarté*, 1919, and *La Lueur dans l'Abîme*, 1920.

**BARCA (EL MERG)**, a city in Cyrenaica, northern Africa, founded in the 6th century B.C., supposedly by Greeks and Libyans. The city stood on the highland of Jebel Akhdar, a few miles from the coast. It was taken by the Persians in 512 B.C. and later fell under the power of the Ptolemies. Rome had large granaries here. The Arabs came into possession in 641. To-day the name Barca is applied to the district between Egypt and the Gulf of Sidra, the Mediterranean Sea and the Libyan desert, and is an Italian possession. The modern city has a popu-

lation of 3,000 and is connected by rail with Bengazi.

**BARCELONA**, the chief manufacturing city, and second seaport of Spain, situated on the Mediterranean near the French border. At one time the capital of Catalonia, Barcelona has been the capital of the Spanish province of the same name since 1833. In the 9th century the town was lord over other settlements, and in the 13th century its sea-borne trade was comparable to that of Venice and Genoa; in the 15th century it held out for ten years against its suzerain, John of Aragon, and in the centuries following its relations with the governing power of Castile and Aragon continued to be unhappy. The activity of those wishing Catalanian independence has centered in Barcelona for a long time. During the past 100 years its history has been marked by several outbreaks of social, political and industrial unrest. Its celebrated university was founded in 1430.

Barcelona is an airport on the routes from France to Morocco and from central Europe to Madrid. The city has an excellent harbor, the growth and improvement of which have been almost continuous since about 1875. Among the numerous manufactures—machinery, furniture, leather, dyes, soap and drugs—the textile industry ranks high. Surrounded by a fertile and well-cultivated fruit district, Barcelona exports wine, olive oil and cork as well as textiles. Est. pop. 1931, 900,000.

**BARCHESTER TOWERS**, the second novel in the Barsetshire series, by ANTHONY TROLLOPE; published 1857. When the newly appointed bishop assumes his office at Barchester Towers, he brings with him a wife whose social ambitions would cause considerable trouble in any midland village. The narrative centers chiefly on church politics and the double-dyed intrigues of a small town. Important minor characters are Dr. Slope, the scheming curate; Signora Neroni, a lady of conquests; Mr. Stanhope; and the clever young widow, Eleanor Bold.

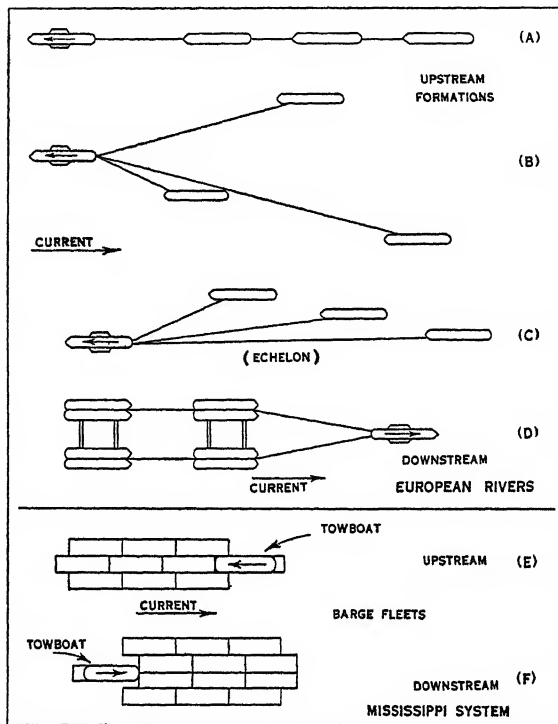
**BAREILLY**, a city in British India, United Provinces, situated on the Ramganga River. The inhabitants of Bareilly are largely Mohammedan, of Afghan stock who migrated about 1720. Since the Mutiny of 1857, a group of these have maintained a hostile attitude toward the Hindus. Pop. 1931, 144,173.

**BARFRUSH** or **BALAFRUSH**, a town of Persia, in the province of Mazandaran, situated about 15 mi. from the shore of the Caspian Sea in a flatland on the River Babil (Bahbul). A good road connects with the port of Meshed-i-Ser, and a road from Teheran to the coast passes through the town. Barfrush is the largest town of Mazandaran and has considerable commerce in hemp, cotton, flax, dried fruit, metals and sugar cane. At one time it had a population of about 200,000 but repeated epidemics have brought it down to about 30,000 in 1930.

**BARGE LINES** operate on inland waterways (see INLAND WATER TRANSPORTATION) in more or less regular service. Such lines may be: 1. Publicly owned and operated, as the Federal Barge Line on the Mis-

issippi river system; 2. Common-carriers, transporting goods for hire under public regulation; 3. Contract carriers, or 4. Private lines, such as those of steel, coal, oil and building-materials companies operating on the Ohio-Mississippi river, and other waterways.

Depending on many factors, BARGES are towed astern by lines, or pushed ahead in a rigid formation. Towing astern is common practice on European water-



BARGE LINE TOWING FORMATIONS

Showing upstream formations on European rivers (A, B and C) and on the Mississippi (E), European downstream formation (D) and Mississippi downstream formation (F)

ways while barges in rigid fleets ahead is more usual on U.S. waterways. Some of the advantages claimed for the American system are that the propeller stream does not re-act on the tow, increasing resistance to towing; that there is less frictional resistance to towing in close formations; and that steering is easier and simpler. Fleets are sometimes towed astern in echelon or double echelon formations upstream and with barges abreast downstream. F. R. H.

**BIBLIOGRAPHY.**—Chief of Engineers, U.S.A. reports, *Experimental Towboats*.

**BARGES**, flat bottomed vessels for transporting freight on rivers, canals, harbors, and other inland waterways; for loading and unloading large vessels, in which case they are commonly called "lighters"; for supplying fuel, water, and other products to large vessels; and for special purposes, such as to carry derricks, or construction plant. Barges may be "towed" or "self propelled."

Barges are usually built of steel or timber, their "lines" being generally simple; variations from rec-



BARBIZON SCHOOL OF PAINTING

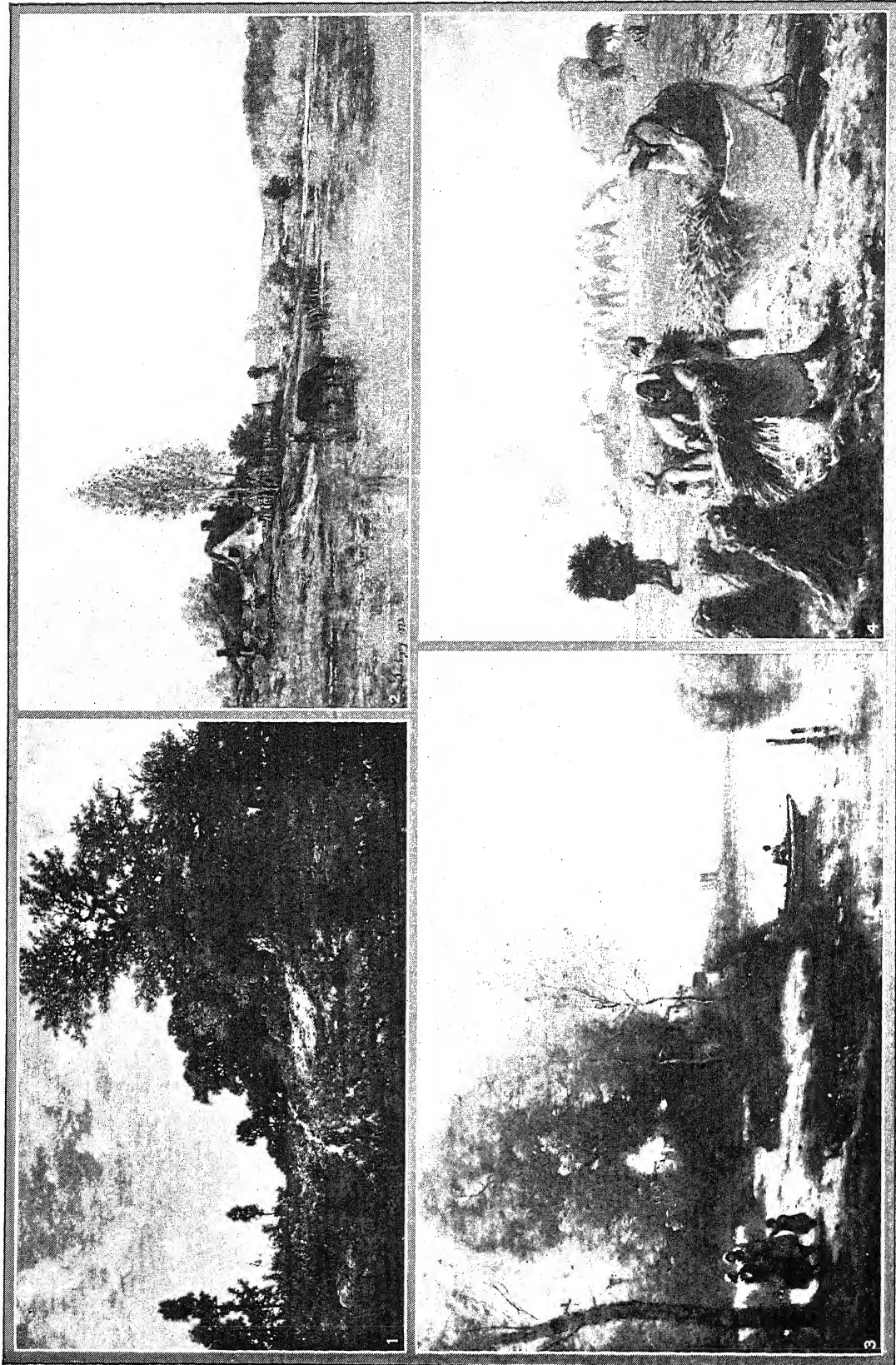


COURTESY METROPOLITAN MUSEUM OF ART

"THE SLEEP OF DIANA"

By Jean-Baptiste Camille Corot (1796-1875).

# BARBIZON SCHOOL OF PAINTING



2, 4, COURTESY BOSTON MUSEUM OF FINE ARTS; 1, 3, METROPOLITAN MUSEUM OF ART

## NINETEENTH CENTURY FRENCH ART—THE BARBIZON SCHOOL

1. "Edge of the Woods," by Théodore Rousseau (1812-67).
2. "Banks of the Oise," by Charles François Daubigny (1817-78).
3. "La Rivière à la Tour Lointaine," by J. B. Corot (1796-1875).
4. "Buckwheat Harvest," by Jean François Millet (1814-75).

tangular form, such as "ship-shape," "raked," and "spoon ends" being introduced to reduce resistance to towing or propulsion, as shown in the figure. Proper "shaping" helps when barges are towed singly or in line, but shaping increases resistance over that of simple short-raked types when barges are towed fastened together in fleets. Types vary also with goods to be transported and other service conditions. Capacities vary from a few tons to several thousand tons. See also BARGE LINES; INLAND WATER TRANSPORTATION.

F. R. H.

**BARHAM, RICHARD HARRIS** (1788-1845), English humorist and ecclesiastic, better known as Thomas Ingoldsby, was born at Canterbury, Dec. 6, 1788. The *Ingoldsby Legends*, a series of metrical verses in which much antiquarian erudition was expressed in a light, whimsical vein, made him a lasting reputation. He died in London, June 17, 1845.

**BAR HARBOR**, an unincorporated village in a township of the same name in southeastern Maine, situated as a port of entry on Mount Desert Island, about 46 mi. southeast of Bangor. It is connected with the mainland and the Ellsworth Maine Central Railroad station by both bridge and bus, and is served by nation-wide bus systems and, *via* Rockland, by boats to New York City and Boston. Bar Harbor is a famous and fashionable summer resort. Acadia National Park, of 15,000 acres, and Abbe Memorial Museum are points of interest. The village was founded in 1763. Pop., town, 1920, 3,662; 1930, 4,486.

**BARI DELLE PUGLIE**, a city of Italy, capital of the province of the same name and of Apulia, the third largest seaport on the Adriatic and, next to Naples, the most important city in southern Italy. On the tongue of land between the old and the new harbor is the ancient city with narrow, crooked streets, containing many fine medieval monuments. The basilica of St. Nicola was begun in 1087, the crypt consecrated in 1089, and the edifice completed in 1108. The cathedral was built in the 12th-13th centuries, to a great extent in imitation of the basilica. The citadel was erected by Emperor Frederick II. In contrast, the new city, started in 1813, has wide streets intersecting at right angles, with fine promenades and imposing buildings. It is the seat of an archbishop, numerous officials, many vocational, advanced and other schools, and a university opened in 1925. Bari delle Puglie has regular steamship service to the other Adriatic ports and to some in the Levant. The old Roman *Barium*, it was, like most Italian cities, frequently fought over by various factions. From 840 to 871 it was a leading strategic point of the Saracens; then it was the seat of a Byzantine governor, until it was captured by Robert Guiscard in 1071. William I of Normandy destroyed the city in 1156, but it was rebuilt in 1166 and later favored by the Anjous. After the temporary régime of the Sforzas, the city was assimilated by Naples in 1558. Pop. 1931, 171,810.

**BARING-GOULD, SABINE** (1834-1924), English author and divine, was born at Exeter, Jan. 28,

1834. A graduate of Cambridge, his prolific and versatile pen turned out works of fiction, history, travel, folklore, topographical and mythological studies, sermons and hymns, including *Onward, Christian Soldiers*. After his father's death he lived the life of a clergyman-squire at Lew Trenchard, North Devon, studying country life, making antiquarian researches, collecting Old English songs and encouraging the studying of old ballad-music. Baring-Gould's novels include *Mehalah*, 1880, and *Broom Squire*, 1896; his research, *Curious Myths of the Middle Ages*, 1866, and *Curious Survivals*, 1892.

**BARITE**, the sulphate of **BARIUM**, called also heavy spar because of its high specific gravity (4.5). It is usually white but may incline to tints of yellow, gray, blue, red or brown, and varies from transparent to opaque. Barite is a common gangue mineral in **ORE DEPOSITS**, especially those of silver, lead and zinc, and often occurs in **VEINS** and fractures in limestone. Because of its insolubility it is also found as a residual product of rock-**WEATHERING**. The most productive deposits in the United States are those associated with the lead and zinc ores of Washington co., Mo. Barite is used in the manufacture of paint, especially of lithopone, consisting of Barium sulphate and zinc sulphide. It is used for treating rubber, for filling paper and for tanning. Barite paint is used by packers on ham sacks and cheeses. See also **GANGUE**.

**BARIUM**, a metal of the alkaline earth family (Symbol, Ba; At. wt. 137.37; melting point, 1216° F.; sp. gr. 3.66). It possesses a silvery luster when freshly cut, is slightly harder than lead and may be readily rolled into a sheet. Barium is very active chemically. It burns vigorously in oxygen, nitrogen and hydrogen, it decomposes water, liberating hydrogen, and reduces the compounds of most metals. It is produced by the action of aluminum or silicon upon barium oxide in a high vacuum at temperatures above 1800° F. Its chief use is as a "getter" to clean up the residual gas in radio tubes and in the form of a nickel alloy in the manufacture of gap wires in spark plugs.

Its soluble salts are exceedingly poisonous. Barium sulphide (BaS) is used as an ingredient in many "patent medicine" **DEPILATORIES** (hair removers). The sulphate of barium (barium sulphate) is so exceedingly insoluble that it can be given with safety internally for the purpose of casting a shadow in roentgen ray examination.

A. J. K.

**BARK**, the tough external covering of woody stems, branches and roots, including the dead outer portion and also the living tissues down to the wood. Bark varies greatly in structure in different plants. Generally it is arranged in concentric layers, which, as the stem thickens, become distended, the outer portions cracking to form the characteristic markings of various trees. The medicinal and other properties of plants, such as tannins and various alkaloids, are commonly abundant in the bark.

**BARK-BEETLE**, a minute, cylindrical beetle of the family *Scolytidae*, some 150 species of which are



found in the United States. They do enormous damage to coniferous forest trees. The adult beetles enter the bark on the main trunk and dig a burrow into the inner bark, where they lay their eggs. Each larval burrow is narrow at first but widens as the larva grows. At the outer end an emergence hole leads to the surface of the bark. The beautiful patterns formed by these burrows on the surface of the wood has suggested the name "engraver beetles" for some members of this group. When the larvae hatch, they dig a series of burrows, radiating out from the original one. The vitality of the tree is greatly weakened, and if it is completely girdled by the burrows, it dies. The first evidence of these beetles is the presence of pitch tubes on the trunks of spruce trees, or reddish boring-dust on the bark or on the ground. Later on the foliage turns reddish or yellowish. The best method of controlling this pest is by felling and removing the bark from the trees.

**BARKENTINE.** See SHIPS, TYPES OF.

**BARKER, LEWELLYS FRANKLIN** (1867- ), noted American physician, was born in Norwich, Ontario, Canada, September 16, 1867. He received the degree of M.B. from the University of Toronto in 1890, and subsequently studied at Leipzig in 1895 and at Munich and Berlin in 1904. Doctor Barker taught anatomy in Johns Hopkins University, 1894-97, serving also as resident pathologist, 1894-99. He was associate professor of anatomy, 1897-99, and of pathology, 1899-1900. He became professor and head of the department of anatomy at Rush Medical College in 1900, continuing until 1905, when he became professor of medicine in Johns Hopkins University. In 1913, Doctor Barker was made emeritus professor of medicine at Johns Hopkins, since which time he has conducted private practice and contributed largely to medical literature. He is a member and has been president of many important medical organizations and a leader in movements for giving modern medical care to the middle classes at a price they can afford to pay. His published works include volumes on diagnosis, on anatomy, on the glands of internal secretion and a book entitled *The Young Man and Medicine*. M.F.

**BARKHAUSEN OSCILLATOR**, a vacuum tube (see TUBES, ELECTRONIC) and circuit arrangement for generating ultra-high-frequency currents. The tube is the three-element type. The grid is maintained at a high positive potential with respect to both CATHODE and plate. The time of flight of an ELECTRON from cathode to plate is a controlling factor in the frequency of current generated. This OSCILLATOR is used for ultra-short-wave radio transmission.

**BARKIS**, a droll character in Dickens's *David Copperfield*. Barkis is best known for his odd proposal of marriage to David's old nurse, Clara Peggotty, which he made in a note saying simply "Barkis is willin'," a proposal which was heartily accepted.

**BARKLA, CHARLES GLOVER** (1877- ), English physicist, was born at Widnes, Lancashire, June 7, 1877. He studied at Cambridge University and

in 1905-09 was successively demonstrator in physics and lecturer in advanced electricity at Liverpool University. During 1909-13 he was professor of physics at the University of London, in 1913 becoming professor of natural philosophy at the University of Edinburgh. He made researches in electric waves and X-rays and in 1917 he received the Nobel Prize for physics.

**BARK-LOUSE.** See SCALE, SCALE-BUG.

**BARLAD** or **BÊRLAD**, capital of the Rumanian district of Tutova, on the river of the same name, a tributary of the Sereth. The city is in the center of an agricultural section and has a large grain trade and food-products industry. Pop. 1930, 26,189.

**BARLEY**, an annual herb (*Hordeum vulgare*) of the grass family, supposedly a native of northwestern Asia. It is one of the most ancient of cultivated plants and is now grown in practically all temperate climates. According to the Waiki, one of the Chinese sacred books, it was cultivated in the Orient 4,000 years ago; during the time of the Pharaohs it was an important crop in Egypt whence it reached Europe by way of ancient Greece and Rome. Barley thrives in a wider range of climates than corn, rice, or wheat, being successfully ripened in lat. 70°, as in North Alaska and Lapland, and also in subtropical climates, as in Arabia and India.

In ancient times and until about the 15th century this grain was largely used in Asia, Europe and Africa for human food, being ground and made into bread. Better cereals introduced later have limited it largely to the manufacture of breakfast foods, pearl barley for thickening soups, and malt. When cut in the "early milk" stage, barley makes good hay. As a stock feed it is sometimes fed whole but preferably crushed. After it is ground its high percentage of gluten makes it sticky when wetted. In the oats states it is not popular as a horse feed, but is highly esteemed in the production of pork, ham and bacon and in poultry feeding.

Barley readily adapts itself to a wider range of soils and cultural conditions than any other cereal. However, it thrives best and yields most when sown on land in good tilth rather than virgin soils. As the plant has a shallower, smaller root system than oats or wheat, it should be sown in early spring but not until the ground has lost its excess moisture. Best yields are generally obtained on rich clay loams. The seed bed must be well prepared, preferably by fall plowing but spring harrowing as early as the ground can be worked. If the surface is lumpy a planker or a roller should follow the discing and the job finished with a fine tooth harrow ready for seeding, preferably with a drill. After drilling this harrow should be used in any case to break up earth clods and lumps of manure.

No other cereal is so well adapted to act as a "nurse crop" for grass, alfalfa, and clover. As it is shorter and less leafy than wheat or oats, it shades the ground less; since it rarely lodges or breaks down when wind-swept, it insures an even stand of the nursed crop.

**BARLEY PRODUCTION, U.S.,**

7-Year Average, 1924-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES . . . .	10,067,000	261,785,000	100.0
LEADING STATES:			
Minnesota . . . . .	1,566,000	44,847,000	17.1
North Dakota . . .	1,895,000	38,742,000	14.8
California . . . . .	991,000	29,381,000	11.2
South Dakota . . .	1,331,000	29,329,000	11.2
Wisconsin . . . . .	589,000	20,657,000	7.9
Illinois . . . . .	386,000	11,490,000	4.4

Barley should not be sown continuously on the same area. A favorite four year rotation where feasible is corn, beets or potatoes, followed by barley with clover and timothy or blue grass, the clover to be cut once or twice and the land used for hay or pasture the following year, then manured in the fall or the winter for corn again.

M. G. K.

**BARLEYCORN, SIR JOHN**, a popular term used to personify strong spirits and liquors. The name was popularized by Robert Burns, though it came into use previous to Burns's poem in a pamphlet of uncertain date, called *The Arraigning and Indicting of Sir John Barleycorn, Knt., Printed for Timothy Tosspos*. *John Barleycorn* is also the title of a novel by Jack London, published 1913.

**BARLOW, JOEL** (1754-1812), American writer and diplomat, was born at Redding, Conn., Mar. 24, 1754. He served as chaplain in the Revolutionary Army, founded *The American Mercury*, a weekly, and wrote a long, pretentious poem, *The Vision of Columbus*, 1787, which was much read at the time, although to-day the mock-heroic *Hasty Pudding*, 1793, is better known. In France, Barlow instigated the founding of Gallipolis, O., by a group of Frenchmen. Becoming a liberal and a republican, he published numerous radical essays. In 1792 he became a French citizen. As Consul at Algiers Barlow secured the release of American prisoners held for ransom, but failed in his attempt, as American plenipotentiary, to interview Napoleon. Caught in the retreat from Russia, he died near Cracow, Poland, Dec. 24, 1812.

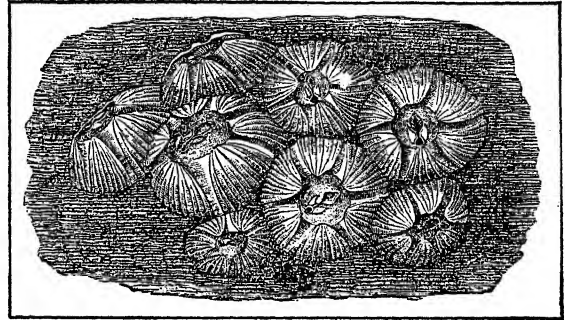
**BARLOW'S DISEASE.** See CHILDREN, DISEASES OF.

**BARMEN.** See WUPPERTAL.

**BARNABAS**, a saint of the Christian Church, originally known as Joseph, a Levite. He was born in Cyprus and became a convert to the Christian faith, being noted particularly for his warm human sympathy, piety and generosity of spirit. PAUL and he visited the Holy Land where the former met the Apostles. The course of Barnabas's career after his departure from Jerusalem is virtually unknown. Although considered an apostle, he was not one of the original twelve.

**BARNACLE**, the popular name for members of a subclass (*Cirripedia*) of the Crustacea. They were long considered mollusks, for in the adult they are attached sedentary animals, and the more familiar

forms have mollusk-like shells. Only in their free swimming larval stages do they look like other crustaceans. They differ from most creatures of their phylum (Arthropoda) in that most of them are hermaphrodites.

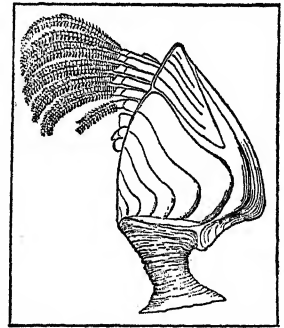


WHALE BARNACLE  
*Coronula diadema*

The best-known order is that of the acorn barnacles (*Balanomorpha*) which encrust rocks, piles and floating timbers on every seashore. They have roundish shells with a hole at the top which can be closed by four small plates. There is no stalk; the shell is cemented directly to the rock or wood.

Also familiar are the stalked barnacles (*Lepadomorpha*). There are not very many species, but they are distributed all over the world, for they ride from shore to shore on the bottoms of ships. The common goose or ship barnacle (*Lepas anatifera*) has a shell of five plates, and a head much elongated to form a fleshy stalk by which it is attached. In the Middle Ages goose barnacles were believed to grow into barnacle geese.

Acorn and stalked barnacles feed on minute organic matter, which they obtain from currents of water kept flowing toward their mouths by their numerous delicate feet.

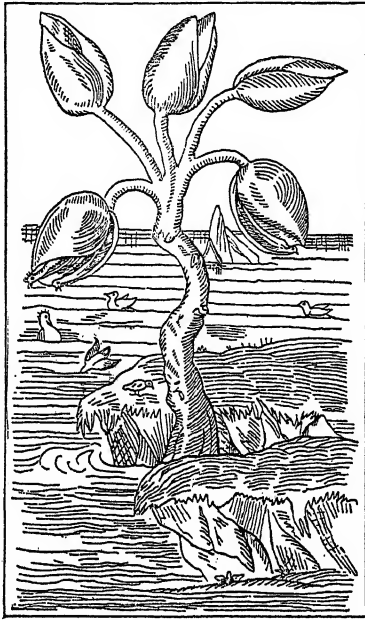


GOOSE BARNACLE  
*Lepas fascicularis*

Other cirripedes (*Acrothoracica*) are degenerate, and bore into the shells of mollusks, and some (*Ascothoracica*, *Apoda*, *Rhizocephala*), like the *Sacculina*, which has long been considered the supreme example of degeneracy, are true parasites. A. I. W.

**BARNARD, FREDERICK AUGUSTUS PORTER** (1809-89), American educator, physicist and mathematician, was born at Sheffield, Mass., May 5, 1809. He graduated from Yale University in 1828 and was made a tutor. At his suggestion the tutors divided up the subjects according to their special knowledge, an innovation since followed. For two years he taught at the Deaf and Dumb Institution at Hartford and from 1832-37 in a similar school in New York. From 1837-54 he was professor of nat-

ural philosophy, mathematics and English literature at the University of Alabama and from 1855-61 was at the University of Mississippi, first as professor, then president and later chancellor. The university was



BARNACLES PRODUCING GEESSE  
In the Middle Ages, barnacle geese were believed to be produced by barnacles.  
From a contemporary drawing by Gerarde

closed during the Civil War. In 1864 he was elected president of Columbia University, holding that office until 1888. During his administration plans were laid along which Columbia subsequently developed into a great university. Pres. Barnard was indeed the architect. In recognition of his efforts to open the doors of Columbia to women during his administration, Barnard College was named after him. Barnard achieved signal distinction in scientific as well as educational fields. In 1860 he participated in the Labrador expedition to observe the eclipse of the sun and was head of the Map and Chart Department of the United States Coast Survey in 1863. Barnard was one of the founders of the American Association for the Advancement of Science and the National Academy of Sciences. He died at New York, N.Y., Apr. 27, 1889.

Among his writings are *Collegiate Education*, 1854; *History of the United States Coast Survey*, 1857; and *Recent Progress of Science*, 1869. M. R.

See J. Fulton, *Memoirs of Frederick A. P. Barnard*.

**BARNARD, GEORGE GREY** (1863- ), American sculptor, was born at Bellefonte, Pa., May 24, 1863. He studied at the Chicago Art Institute and in Paris, and his early works showed the influence of AUGUSTE RODIN. His great bronze statue of Lincoln, in Lytle Park, Cincinnati, caused much comment at the time of its unveiling in 1917; but to-day Barnard has taken his place among the ultra-conservatives. His works

include: *Two Natures*, Metropolitan Museum; *Great God Pan*, Central Park, New York; *Adam and Eve*, Boston Museum of Fine Arts; and the 31 heroic figures on the State Capitol at Harrisburg, Pa.

**BARNARD, HENRY** (1811-1900), American educational pioneer, was born at Hartford, Conn., Jan. 24, 1811. He graduated from Yale University in 1830, taught for a time and read law. From 1833-34 he studied at Yale Law School, and was admitted to the bar in 1835. From 1837-40 Barnard was a member of the Connecticut legislature. He was public school commissioner of Rhode Island from 1843-49 and during that time completely changed its educational system. He was both superintendent of the Connecticut State schools and principal of the State Normal School in New Britain, Conn., from 1850-55. The first teachers' institutes held in America were organized by him. Barnard was chancellor of the University of Wisconsin 1858-60. When St. John's College at Annapolis reopened after the Civil War he became president but resigned this office at the end of a year to become United States Commissioner of Education, the first one to hold that position. In 1867 he organized the United States Bureau of Education. Barnard was the author and editor of many works on education. He founded the *American Journal of Education* in 1855 and was editor until 1886. The same year he published his articles in the *American Library of Schools and Education*. He died at Hartford, Conn., July 5, 1900.

See B. C. Steiner, "Life of Henry Barnard" in the *Bulletin of the Bureau of Education*, No. 8, 1919.

**BARNARD COLLEGE**, a non-sectarian institution for women of COLUMBIA UNIVERSITY, in New York City, was opened in 1899. The college was named after FREDERICK A. P. BARNARD, who as president of Columbia had struggled to open the doors of the university to women. In 1900 Barnard was incorporated as a semi-independent institution. That is, the president of Columbia University is ex-officio president of Barnard, and he appoints, with the consent of the trustees of Barnard, the dean, and with the approval of the dean the faculty of the college. The degrees are conferred by Columbia University. Its courses are determined by its own faculty. Barnard College has productive funds providing an income of approximately \$180,000. In 1930 there were 1,104 students and a faculty of 127, headed by Dean VIRGINIA C. GILDERSLEEVE.

**BARNARD'S STAR**, a faint star of the tenth magnitude in the constellation OPHIUCHUS. Its proper motion is the largest now known, 10".25 annually, and sufficient to carry the star over a distance equal to the moon's angular diameter in 175 years. Barnard's Star is nearer to us than any star except the system of Alpha and Proxima Centauri, being only 6 light years distant. It is 2,500 times fainter than the sun, and has a speed of 90 miles per second. See *STAR: map*.

**BARNAUL**, an administrative town in Western Siberian Region, R.S.F.S.R., on the Ob River, 240

mi. southwest of Tomsk. It is located on a branch of the Trans-Siberian railway, near the Altai Mountains and the Kuznetz Basin. Barnaul is a distributing point for silver, copper, lead, zinc, coal, iron and gold. The neighborhood abounds in peat bogs. The railway and the Ob, which is navigable, also make the town an exchange center for dairy products and livestock. It was founded in 1744. Barnaul has important smelting plants, flour mills, two museums, a mining school, hospitals, a meteorological observatory, and several libraries, and is the fourth largest town in Western Siberia. Pop. 1926, 73,858.

**BARN BURNERS**, the antislavery faction of the Democratic party in New York State, 1843-52, named probably in derisive allusion to the traditional Dutch farmer who burned his barn to get rid of the rats. In 1844 the failure of the conservative faction, the HUNKERS, to support MARTIN VAN BUREN in the national Democratic convention was a contributing factor to the nomination of JAMES KNOX POLK. Polk threw the weight of the Federal patronage against the barn burners, intensifying the factional antagonism. When in the state Democratic convention of 1847 a resolution expressing hostility to the extension of slavery was defeated, the barn burners withdrew, nominating a contesting delegation to the national convention. The national Democratic convention, 1848, wishing to avoid the loss of either faction, admitted both delegations, allowing each delegate half a vote. The barn burners, dissatisfied, and certain that the convention would nominate a candidate favorable to slavery extension, withdrew. Holding another state convention, at Utica, they resolved that the refusal of Congress to use its power to exclude slavery from the territories was a negation of democratic principles, and nominated Van Buren for president. Endorsed also by the FREE-SOIL PARTY, Van Buren polled 291,263 votes, sufficient defection from the Democratic ticket to elect ZACHARY TAYLOR, the Whig candidate. The reconciliation of the barn burners and the hunkers in 1852 was a matter of political expediency.

**BARNES, MARY SHELDON** (1850-98), American educator, was born at Oswego, N.Y., Apr. 24, 1850. She was educated at the Oswego Normal School and at the University of Michigan, where she graduated in the first class which included women. Later she studied at Cambridge and the University of Zurich. She was professor of history at Wellesley from 1876-80, at Oswego Normal School, 1882-84, and at Stamford University, 1891-96. Mrs. Barnes was a pioneer in the development of the source method of teaching and was the first to apply the Pestalozzian method to the teaching of history. She died at Los Angeles, Cal., July 18, 1898.

**BARNs.** A well-planned layout of barn structures and equipment is essential to convenience and economy in the care of live stock, and certain standard arrangements have been accepted. Cows and horses are stabled in stanchions and tie stalls, respectively, usually arranged in two rows extending the length of the barn. Individual box stalls are used for blooded

and valuable animals, while pens are sometimes used for groups of sheep, beef cattle and mules where the barns are devoted to the care of only one kind of these animals.

In Northern climates, warm shelters are needed and provision for ventilation is necessary; also, the barns are often grouped close together or connected by a covered wall for protecting the farmer as he goes to and from the different buildings. In temperate climates open sheds are frequently used.

The general arrangement of barns should be carefully planned to save labor in feeding and in the case of dairy barns, to conform with local dairy regulations regarding the handling of market milk. In large modern barns Gothic and gambrel roofs are used to provide a mow without posts. Most barns are of wood, but masonry and metal are coming into use.

**Barn Ventilation.** The difference of temperatures between the inside and outside air is the chief factor affecting barn ventilation. Inside air, when warmed by animals, becomes lighter than the cold outside air and rises as the outside air enters. The greater the difference in the temperatures the more rapid is the movement of the air. The fact that air absorbs moisture as it is warmed is utilized in connection with ventilation to dry barns. In a stable, air is changed by providing outlets in the roof through which the warm moist air escapes.

To control the inside temperature and humidity, under varying weather conditions, various arrangements of inlets and outlets, designed to operate by gravity or fans, are advocated. The King system provides a number of small inlets and one or more large outlets. Fresh air enters above the sills, and rises between the studding into the stable at the ceiling. Outlet flues extend from near the floor through the mow to the roof ventilators. The Rutherford system reverses the position of the inlets and outlets and uses outlets having twice the area of the inlets. See also DAIRY BARNs; HOG HOUSEs; AGRICULTURAL STORAGE.

T. A. H. M.

**BIBLIOGRAPHY.**—Farmers' Bulletin 1393, *Principles of Dairy Barn Ventilation*; Farmers' Bulletin 1350, *Beef Cattle Barns*; Farmers' Bulletin 1342, *Dairy Barn Construction*.

**BARNsLEY**, a town in west Yorkshire. It is situated west of the Dearne River in the coal section; Sheffield lies about 15 mi. to the south. Wire-drawing was the principal industry in early times, but this declined with the development of the coal mines which in normal times supply employment for most of the laborers in Barnsley. Additional industries are glass, iron and steel works, sawmills and establishments for the printing and bleaching of calicoes. Serving the town are 4 railroads and a canal making direct connection with Hull and London. A park, libraries, markets and baths are supported by the town. Pop. 1931, 71,522.

**BARNSTABLE**, a town including the village of Barnstable and 13 other villages, in eastern Massachusetts. Barnstable village is the county seat of Barn-

stable Co., on Cape Cod. The town is situated between Cape Cod Bay and Nantucket Sound. The New Haven Railroad, bus lines and two airports serve the villages. The summer visitors to this delightful resort are the chief source of income. Cranberries are the principal crop of the neighborhood and fishing is a leading industry. Hyannis, the trade center of the Cape, and the seat of a State normal school, is a village included in the town. Barnstable was settled and incorporated in 1639. It was the birthplace of the patriot, James Otis and, according to tradition, the home of Priscilla Alden. Pop. 1920, 4,836; 1930, 7,271.

**BARNSTABLE**, a seaport and municipal borough of Devonshire, England, situated on the Taw 8 mi. from the north coast. Traditionally of Saxon foundation, it was once an important seaport, but has suffered from the silting up of the harbor. The castle was Norman, as was the Cluniac priory of which same fragments survive. Barnstable's ancient parish church boasts a crooked wooden spire, and its 14th century grammar school was attended by Gay, author of the *Beggar's Opera*. There also is a 13th century arched bridge. The town once famed for woollens, to-day manufactures laces and gloves, and has foundries and potteries where the well-known Barum Ware is made. Pop. 1921, 14,409; 1931, 14,693.

**BARNUM, PHINEAS TAYLOR** (1810-91), American circus owner and showman, born at Bethel, Conn., July 5, 1810. At first a shop keeper, he later edited a weekly paper, *The Herald of Freedom*, and then toured the country (1835) with Joyce Heth, a negress, whom he claimed was 160 years old. In 1841 he acquired a museum in New York City, exhibiting as chief attraction, the celebrated dwarf "General" Tom Thumb. He

became the American impresario of Jenny Lind in 1850, and in 1871 founded Barnum, Bailey & Hutchinson—"The Greatest Show on Earth"—later to become world famous as Barnum & Bailey, which he finally sold to Ringling Brothers. He wrote an *Autobiography* (1854), and was author of *Humbugs of the World* (1865). He died at Bridgeport, Conn., April 7, 1891.

**BARN VENTILATION.** See **BARN.**

**BARNYARD GRASS** (*Echinochloa crus-galli*), a coarse annual, native to Europe and widely diffused in North America as a

edible seed is known in the United States as billion dollar grass. Barnyard grass was the original host plant of the destructive European corn-borer.

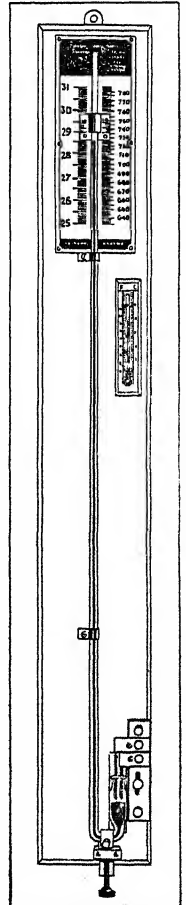
**BARODA**, a native state of British India, in the Gujarat region, north of Bombay. It comprises 8,135 sq. mi. The state was created out of the remains of the Mogul Empire and came under British suzerainty in 1802. It is governed by a native ruler who is assisted by executive and legislative councils. Baroda, situated 250 mi. by rail north of Bombay, is the capital. The soil of Baroda is fertile, producing maize, wheat, rice and other crops. There are numerous co-operative societies. The average annual revenue is about \$8,000,000. A Resident at Baroda represents the British government of India. Pop. 1921, 2,126,255; 1931, 2,442,924.

**BARODA**, the capital of one of the most important Indian states of the same name, in the Gujarat province, is situated on the River Viswamitri. Though of considerable age, the city is very modern in appearance, due to its carefully laid out wide streets, large parks and modern architecture. Pop. 1921, 94,712; 1931, 112,862.

**BAROGRAPH**, the name given to a self-registering ANEROID BAROMETER, used in making a continuous record of the atmospheric pressure from hour to hour or in recording the height of AIRCRAFT. A pen, or stylus, attached to the end of the pointer of the barometer draws a continuous line on a chart mounted on a drum rotated by clockwork. Since the pressure of the air varies directly with the altitude, the barograph can be scaled to record altitudes as well as pressures. A sealed barograph is carried in all planes attempting record altitude flights. See also **BAROMETER**.

**BAROMETER**, an instrument for measuring the atmospheric pressure. There are two general types in common use, the mercury and the aneroid. The former utilizes the fundamental idea of balancing a column of mercury, whose weight is known in terms of its dimensions and specific gravity, against the pressure or weight of the ATMOSPHERE. The ANEROID BAROMETER comprises a vacuum chamber with elastic metallic sides which are pushed inward by the pressure of the air.

In the mercury barometer, the mercury tube may be "U"-shaped or it may be a straight tube with the lower end immersed in a body of mercury contained in a cistern. In both types, the upper end of the tube



COURTESY WELCH SCIENTIFIC CO.

EXPERIMENTAL MERCURY BAROMETER



FROM JEPSON, MAN. FL. PLANTS CALIF.. COPYRIGHT

BARNYARD GRASS

weed. Its stout stem, 2 to 4 ft. high, often branching from the base, bears smooth leaves, with blades sometimes 2 ft. long, and numerous stiff-hairy, short-awned flowering spikes. A form cultivated in Asia for its



is closed, and the space above the mercury column is completely exhausted of all gas and vapor. With the "U"-tube type, the atmospheric pressure is equal to the product of the difference in the height of the columns in the two sides of the tube and the density of mercury. With the cistern type, the height of the column above the level of the mercury in the cistern is taken. In accurate measurements, corrections must be made for temperature and gravity variations.

The scales of barometers are graduated in inches or millimeters. In the Fortin type, the level of the mercury in the cistern is placed at the zero of the scale by a thumbscrew adjustment. In the Kew type, the scale is graduated to allow for the differences in level of the mercury in the cistern. In the Newman type, the scale is adjustable to the mercury level. *See also* BAROGRAPH.

**BAROMETRIC LIGHT**, the faint flash of light which occurs occasionally above the mercury of a mercurial BAROMETER when it is shaken. It is also seen when any well evacuated tube containing mercury is shaken. The light is due to an electric discharge through the residual gas, the electrification being the so-called frictional electricity obtained by the rubbing of the mercury against the glass and the residual gas.

**BARONS' WAR**, the English Civil War of 1263-67, which was fought between the barons, led by SIMON DE MONTFORT and the royal party. The Provisions of Oxford, drawn up in 1258 by the Great Council, or Parliament, to correct administrative abuses, had established Government by a baronial council. In 1261 Henry III was absolved from the oath he had taken to uphold these provisions, and Louis IX, chosen as arbiter, decided against the barons. Their refusal to accept the decision led to war. The Battle of Lewes, on May 14, 1264, resulted in the King's capture and the restoration to power of the baronial council. In 1265 De Montfort's "Model Parliament," a landmark in English history, was held. From the simultaneous summoning of knights and borough representatives ultimately developed the modern House of Commons. De Montfort was killed and his party dispersed at the Battle of Evesham in Aug. 1265.

**BAROQUE STYLE**, the prevalent style of the latter part of the Renaissance (*see* RENAISSANCE ARCHITECTURE) covering roughly the 17th century, though starting some decades earlier in some places, and lasting occasionally far into the 18th century. Baroque was a reaction from the ideals of refinement, perfection of taste, and academic correctness that characterized the earlier High Renaissance. Its aims were excitement, climax, grandeur, dynamic motion, large scale, and the drama of sudden contrasts. It achieved them by adopting a dominantly sculptural attitude towards architecture, and neglecting structural expression. Building forms were curved, both vertically and horizontally, and broken up into interesting masses of light and shade, with interest of mass and surface as the only end. The Baroque designers worked generally with basically classical elements, columns, en-

tablatures, arches and pediments; but these they used as a sculptor uses drapery, and to them added a great use of urns, cartouches, finials and figure sculpture. Columns were twisted and coupled. Pediments were broken, scrolled and reduplicated. A new study of planning led to magnificent and climactic interiors, with mural and ceiling painting, sculpture and architecture united into one whole, like a musical fugue.

The Baroque style originated in Italy, appearing first in the minor arts as early as 1540. Under the influence of MICHELANGELO, the Baroque appeared in architecture; it reached its Italian climax about 1650. In Spain, its chief flowering appeared later in the Churrigueresque style developed by J. Churriguera (1650-1725). Its most lavish monuments, in which the freedom and eccentricities of the Italian Baroque are far exceeded, and the last remnants of classicism were swamped in gorgeous and contorted lavishness, date from about 1700. In France occasional Baroque elements appear under Henry II; but the style reached its first climax in the heavy handed but often compelling work under Henry IV. Under Louis XIII a reaction towards classicism set in, which grew and dominated all exterior architecture under the following kings. Meanwhile, however, the Baroque spirit came more and more to control interiors, and achieved a new and delicate flowering in the Rococo STYLE. In Germany and Austria the early Baroque influenced early German Renaissance work in developing the use of GABLE forms, strap-work, and elaborate scrolled gables. Later the full classical Baroque was magnificently handled in the palaces, churches and monasteries of Vienna, Munich, Prague, and the neighboring countries. Further north, and later, due to the influence of the French courts of Louis XIV and Louis XV, a more riotous, playful and delicate type of Baroque controlled the early 18th century work of Dresden, Berlin, Potsdam, and the Rhine states. In England, Baroque forms due to Flemish influence are common in the Elizabethan and Jacobean styles. Later, owing to the classical, Palladian enthusiasm of Inigo Jones and his followers, Baroque forms appear only spasmodically.

Important Baroque architects are: in Italy, Galeazzo Alessi (1500-72), Francesco Borromini (1599-1667), Lorenzo Bernini (1598-1680), Felipe Juvara (1685-1735); in France, Salomon de Brosse (1560-1626); Jacques Lemercier (1590-1654), Francois Mansart (1598-1666); in Germany and Austria, Fischer Von Erlach (1650-1723), Lukas Von Hildebrand (1668-1725); the Cuvilliés family. For bibliography *see* RENAISSANCE ARCHITECTURE. T.F.H.

**BARQUISIMETO**, a town of Venezuela, and capital of the state of Lara, situated about 100 mi. southwest of Tucacas, its port. It is situated 1,985 ft. above sea level and has a healthful climate with a mean temperature of 78°. Its chief industry is exporting sugar, coffee and cacao. It was founded by Juan de Villegas in 1552, and in 1812 was entirely wiped out by an earthquake, with a great loss of life. Pop. 1924, 43,451.

**BARRACUDA**, the common name for a family (*Sphyrænidae*) of large spiny-rayed fishes, closely related to the mullets, found chiefly in tropical and warm seas. They are long, slender, swift-swimming, exceedingly voracious fishes, with a large mouth and long knife-like teeth. The larger species sometimes exceed 6 ft. in length, and, where abundant, are highly dangerous to bathers. Most barracudas are excellent food fish, with firm, delicate flesh, but in certain localities the great barracuda is reputed occasionally to be poisonous. The great barracuda (*Sphyræna barracuda*) called also picuda and becuna, a savage fish often 5 ft. but sometimes 10 ft. long, occurs from Brazil northward to South Carolina. The smaller California barracuda (*S. argentea*), sometimes 5 ft. long, found on the coast from San Francisco southward, is highly esteemed for food. In 1929 the commercial catch of barracuda in California waters amounted to 5,229,000 lbs., valued at \$530,000.

**BARRAGE**, in river improvement, an artificial bar or submerged dam constructed to control the water level or divert water. *See* RIVER IMPROVEMENT; DAMS; WEIR. Submerged obstructions placed in streams are called "hurdles."

**BARRAGE**, in warfare, a line of artillery shells fired at close intervals in front of a position, to prevent attacking forces from passing through. This form is known as a standing barrage. When a battery fires a predetermined barrage on signal, it is known as a normal barrage; for batteries not immediately ready, it is an emergency barrage. The successful use in the World War of a barrage for the purposes just mentioned led to its use being extended to cover INFANTRY in an assault, by rolling along in front, destroying men and obstacles as it advances, and screening the infantry by its smoke and dust. This is the rolling barrage. If in addition to protecting the front of the infantry, it is prolonged around the flanks, it is a box barrage. C. H. L.

**BARRANQUILLA**, a city of Colombia, and capital of the state of Atlantico, situated about seven miles above the mouth of the Magdalena River. It is an important commercial center of the country, being connected with the seaport, Puerto Colombia, by a 17-mile railway and being the terminus of all steamer lines navigating the Magdalena River; work has been undertaken to make the Magdalena navigable to the sea. It has a mean temperature of about 85° F. and lies on a low, level plain. The streets are regular and wide, and there is good telephone and telegraph service, a modern water system and airplane service to important cities of Colombia. A United States consulate is located there, and the city has good public and private schools. The chief industry is the exporting of coffee, hides, cotton and petroleum. Barranquilla was founded in 1629. Pop. 1928, 139,974.

**BARRAS, PAUL FRANÇOIS JEAN NICHOLAS, COUNT DE** (1755-1829), French revolutionist, was born at Foy in Provence, on June 30, 1755. As a youth he was stationed in India with the French forces against the British. He took part in the

attacks on the Bastille and the Tuileries, sat in the Convention in 1789, and was a prime mover in the *coup d'état* against Robespierre in 1794, holding practically a dictatorship at the time. In 1795, as commander-in-chief of the army, he called Napoleon Bonaparte to aid him. In the same year, as one of the five directors, he had Bonaparte appointed commander of the forces in Italy, and engineered the marriage of Josephine Beauharnais, his former mistress, and Napoleon. In 1799-97 he controlled the Directory, retiring in 1799 when the Consulate superseded the Directory. Until the Restoration he was suspected of plots to restore the Bourbons, and lived for a time in exile. With the accession of Louis XVIII he could not establish himself in favor. He died in 1829. His *Memoirs*, a source of important details of the Revolution, were published in 1895-96.

**BARR COLONY, THE**, a group settlement in Saskatchewan promoted by the Rev. I. M. Barr, adventurer from the State of Washington. Barr moved to England in 1902 after diverse unsuccessful activities in the United States, and in the British press suggested an all-British settlement in Canada under his guidance. He secured from the Canadian Government homestead reservations west of Battleford; in March and April 1903, some 2,000 colonists sailed under his auspices. Advance agents, lacking capital and experience, had not provided facilities for the colonists. The Immigration Department intervened, erected tent accommodations at Saskatoon, and hired freighters for the 180-mile journey from the railroad to the Barr lands. Barr was deposed by the colonists, May 31, 1903, and a managing committee headed by the Rev. G. E. Lloyd chosen in his stead. About 1,600 of the emigrants reached the lands, and entered 550 homesteads; after the first year's hardships, the settlement prospered moderately.

**BARRE**, a town including Barre village in Worcester Co., central Massachusetts, situated about 25 mi. northwest of Worcester, and served by two railroads. Barre is in a farming district. The local manufactures are woolen goods and high speed machine drills. White pine timber is found in the vicinity. Barre was established as a town about 1775. Pop. 1920, 3,357; 1930, 3,510.

**BARRE**, a city of Washington Co., Vt., 7 mi. southeast of Montpelier, on the Stephens branch of Winooski River. It is served by the Central Vermont and the Montpelier and Wells River railways. Granite quarries furnish the leading industry. Manufactures, notably monuments, quarry machinery and pneumatic tools, had an approximate value of \$9,000,000 in 1929. The retail trade in the same year amounted to \$8,865,313. Goddard Seminary is located in Barre. The city was chartered in 1895. Pop. 1920, 10,008; 1930, 11,307; 30% foreign born.

**BARREL**, a measure of volume and weight which varies with different commodities and in different states. The barrel in liquid measure commonly contains 31½ gals. of 231 cu. in. For solid substances, it is usually a measure of weight, and its size is regu-

lated by the statutes of the states. A barrel of flour is generally 196 lbs. and a barrel of pork or beef 200 lbs. By an act of Congress in 1912, a standard barrel of apples was set as 7,056 cu. in. In Wisconsin, a barrel of potatoes is 176 lbs. and a barrel of unslacked lime is 200 lbs.

**BARRELS.** See COOPERAGE.

**BARRÈS, MAURICE** (1862-1923), French writer and Nationalist, was born at Charmes, Vosges, Sept. 22, 1862. In politics as in literature he advocated an extreme individualism. He edited a Boulangist paper in Nancy while siding with the Nationalists in the Dreyfus agitation. That he was also a loyal son of Lorraine is demonstrated in his masterpiece, *Le Roman de l'énergie nationale*. His most provocative works develop ideas expressed early in his career in *Un homme libre*, 1889, a book strikingly in advance of his generation. Throughout his life, he fought France's battles with his pen. When peace came to France, his still prolific writings discarded all vehemence, and found great charm. Barrès died in Paris, Dec. 5, 1923, leaving a great literary legacy and the unpublished *Mémoires*.

**BARRETT, JOHN** (1866- ), American diplomat, born at Grafton, Vt., on Nov. 28, 1866. He prepared for college at Vermont Academy and Worcester, Mass., Academy, and graduated from Dartmouth in 1889. During 1889-94 he did staff work for San Francisco, Tacoma, Seattle and Portland, Ore., newspapers. He was appointed minister to Siam in 1894, and served until 1898; during this period he settled claims of several millions of dollars. During the Spanish-American War he was press correspondent and special adviser to Admiral Dewey in the Philippines. He was the American delegate to the 2nd Pan American Conference in Mexico in 1900-01. As American minister to Argentina, 1903-04, minister to Panama, 1904-05, and minister to Colombia, 1905-06, he endeavored to establish amicable relations between the United States and the three republics. He was director-general of the Pan American Union from 1907-20, and developed it into a powerful organization. He has published: *Admiral George Dewey*, 1899; *Pan American Union*; *Peace, Friendship, Commerce*, 1911; *Panama Canal—What It Is, What It Means*, 1913; *The Call of South America*, 1924; *Pan Americanism—Our Greatest Opportunity*, 1929.

**BARRETT, LAWRENCE** (1838-91), American actor, was born at Paterson, N.J., Apr. 4, 1838. He made his stage début appearing in 1853, in *The French Spy* at Detroit, Mich. He appeared in New York in 1857 as Clifford in *The Hunchback*. Barrett began his association with EDWIN BOOTH in 1862, and in 1886 entered into partnership with him. Independently Barrett produced and appeared in *Yorick's Love*, 1878, George H. Boker's *Francesca da Rimini*, 1882, Oscar Wilde's *Guido Ferranti*, 1891, while other plays in his extensive repertoire numbered *The King's Pleasure*, *The Fool's Revenge* and in Shakespearean drama, the rôles of Bassanio, Edgar, Laertes, Macduff,

Othello, Iago, Richard III, Romeo, Lear, Hamlet, Shylock and Macbeth. In 1886 he published *Edwin Booth and His Contemporaries*. Barrett died at New York, Mar. 21, 1891.

**BARRIE, SIR JAMES MATTHEW** (1860- ), Scottish novelist and dramatist, was born at Kirriemuir, Scotland, May 9, 1860. He studied at Edinburgh University, and in 1885 moved to London, where he wrote for the *St. James Gazette*. His first book, *Better Dead*, appeared 2 years later. This was followed by a volume of sketches about his native village and by the novel, *When a Man's Single*. It was not till 1893, however, when he had published several books, including the famous *My Lady Nicotine*, that Barrie began to write for the theater: in this year he produced his first play, *Walker, London*. Two years later he published *Sentimental Tommy*, and in 1897 *The Little Minister* was dramatized. In 1904 he wrote *PETER PAN* with which he won the hearts of millions of children. At the beginning of the century Barrie was the most successful playwright on the English stage, and as many as four of his plays ran simultaneously in London. Among his other dramas are *Alice-Sit-by-the-Fire*, 1905, *What Every Woman Knows*, *A Kiss for Cinderella*, 1916, and *Dear Brutus*, 1917. In all his work he is noted for his whimsicality and subtle humour, his blending of comedy and pathos. In 1913 Barrie was made a baronet and in 1922 he received the Order of Merit.

**BARRIE**, the capital of Simcoe Co., Ont., Canada, situated on the north shore of Kempenfeldt Bay, at the western extremity of Lake Simcoe, about 60 mi. northwest of Toronto. It is served by the Canadian National Railway and by numerous lake steamers. Located here are creameries and flour and planing mills supplied by the surrounding farm district. The city also has shoe factories and boat-building and railway shops. Barrie is a favored summer resort. Pop. 1921, 6,936; 1931, 7,776.

**BARRIER REEF**, the sea-level ridge of a coral-reef forming a natural breakwater, paralleling the coastline of an island or continent at considerable distance from the shore. The quiet lagoon it encloses may be from a half-mile to twenty or even thirty miles wide, and 20 to 40 fathoms deep. Barriers are broken at intervals by gaps or "passes" through which vessels enter the lagoon. Upon the seaward face of such reefs where the waves bring plentiful oxygen and food, living corals grow. Low coral-islands supporting vegetation are often built up on portions of a barrier. An *ATOLL* is believed to be a barrier-reef which has continued to grow upward during the gradual submergence of its central island. The most notable of such formations is the Great Barrier Reef which protects the northeastern coast of Australia for a distance of 1,200 miles.

**BARRINGTON**, a town of eastern Rhode Island, on Narragansett Bay. It is served by the New York, New Haven and Hartford Railroad. Bricks, lace, yarns and worsted are produced. Pop. 1920, 3,897; 1930, 5,162.



**BARRIOS, JUSTO RUFINO** (1835-85), President of Guatemala, was born in San Lorenzo, Guatemala, in 1835. He began to study law but soon dropped that profession for a military career. In 1871 he participated in a revolution against President Cerna and became the leader of the Liberal Party. He was made general-in-chief of the army and elected president in 1873, governing until his death. Though he is known as a dictator, he promoted progress through telegraphs and telephones, railroads and education. He also expelled the religious orders and disestablished the church. He was desirous of restoring the Central American Federation, but the other republics made war against him and he was killed on the field on April 2, 1885.

**BARROS ARANA, DIEGO** (1830-1907), Chilean historian and educator. His first historical work in 1850 was followed by numerous writings treating the history of Chile and America in general, and he collaborated in the publication of various reviews. The quality as well as the quantity of his work has earned him the title of the foremost historian of Chile. His contribution to the educational life of Chile was no less important. After a trip to Europe, where he investigated the school systems in use there, he proposed a plan for the complete reorganization of Chilean education, and wrote a series of textbooks to be used in the schools. In 1892 he became rector of the University of Chile. His principal historical works are *Historia general de la Independencia de Chile* (1854-57); *Compendio de historia de America* (1865); *Historia de la guerra del Pacifico* (1880-81); *Historia general de Chile* (1884-86).

**BARROW-IN-FURNESS**, a seaport and municipal borough of Lancashire, England, situated in the southwestern part of the Furness peninsula, about 18 mi. northwest of Lancaster. Some of the largest iron and steel factories of England are located here, and the production of ships, railway cars, wire and metal goods, jute and flax has become increasingly important. Airships are manufactured on the nearby island of Walney. Included among the numerous public buildings is a Carnegie library, established 1922. Pop. 1921, 74,244; 1931, 66,366.

**BARROWS, DAVID PRESCOTT** (1873- ), American educator, was born at Chicago, Ill., June 27, 1873. He graduated from the University of Chicago in 1895 and was appointed superintendent of schools at Manila in 1900. From 1903-09 he was director of education in the Philippines and was president of the University of California from 1919-23. Barrows was a member of the Committee of Relief for Belgium in 1916 and was decorated by France, Belgium, Japan, Italy and Poland. He wrote *A History of the Philippines*, 1903, and *Berbers and Blacks*, 1927.

**BARRY, SIR CHARLES** (1795-1860), English architect and landscape gardener, born in London, May 23, 1795. His chief fame rests upon his design for the Houses of Parliament, Westminster (1840-60), but he is also noted as the architect of the Travellers'

and the Pall Mall clubs, both carried out in the Italian style, and the Manchester Athenaeum and Bridgewater House. He died at Clapham, May 12, 1860.

**BARRY, PHILIP** (1896- ), American dramatist, was born at Rochester, N.Y., June 18, 1896. He was graduated from Yale in 1919, and in 1919-22 studied playwriting at Harvard University under GEORGE PIERCE BAKER. His three-act comedy, *You and I*, produced in 1923 as the Harvard Prize Play, was the first evidence of his skill in writing for the theater. Subsequent plays have revealed a facility for satirizing the American background by means of skilful dialogue, as opposed to satire by action. His highly individualistic technique has been illustrated by such successful plays as *In A Garden*, 1925, *White Wings*, 1926, *Paris Bound*, 1927, *Holiday*, 1929, *Hotel Universe*, 1930, *Tomorrow and Tomorrow*, 1931, and *The Animal Kingdom*, 1932.

**BARRYMORE FAMILY**, a group of actors and actresses prominent on the American stage. Maurice Barrymore (Herbert Blythe) (1847-1905) was born at Fort Agra, India, in 1847. He was educated at Harrow and Oxford, and studied for the Indian civil service and for the bar. He became an expert boxer and won the British Amateur Championship in 1872. The same year he made his first appearance on the stage at Windsor. In 1875 he made his American debut at Boston, Mass., and was engaged for Augustin Daly's company in which he met his future wife, Georgiana Drew, daughter of John Drew, Sr., by whom he became the father of Lionel, Ethel and John Barrymore (see DREW FAMILY). After playing leading rôles, notably with HELENA MODJESKA, he suffered a mental breakdown, and died at Amityville, L.I., Mar. 25, 1905.

Lionel Barrymore (1878- ), was born at Philadelphia, Pa., Apr. 28, 1878, and made his first stage appearance in 1893 in *The Rivals* in which his grandmother, Mrs. John Drew, Sr., was Mrs. Malaprop. He acted with Nance O'Neill in 1898-99, J. A. HERNE in 1900, and for two seasons with JOHN DREW in *Second in Command* and other productions. After playing the title rôle in J. M. Barrie's *Pantaloon* he retired for three years, reappearing in 1909 in *Fires of Fate*. His outstanding rôles were in *Peter Ibbetson*, 1917, *The Copperhead*, 1918, and *The Jest*, 1919. After playing leading rôles in motion pictures, he began work as a director in 1929.

Ethel Barrymore (1879- ) was born at Philadelphia, Pa., Aug. 15, 1879. She was educated at the Convent of Notre Dame in Philadelphia, and made her stage debut on Jan. 25, 1894, at the Empire Theatre, New York, as Julia in *The Rivals*. After her debut in London with WILLIAM GILLETTE in *Secret Service*, 1897, she was engaged by HENRY IRVING for *The Bells*. Established early as a star she appeared in numerous rôles, including parts in *A Doll's House*, *Captain Jinks*, *The Silver Box*, *Mid-Channel*, *Trelawney of the Wells*, *Deçlassé*, *The Second Mrs. Tanqueray*, 1924, and *Scarlet Sister Mary*, 1930-31.

John Barrymore (1882- ), was born at Philadel-

phia, Pa., Feb. 15, 1882, and was educated chiefly in England. He studied with the intention of becoming an artist and began his career as a cartoonist. In 1903 he appeared, in response to an emergency summons, opposite Ethel Barrymore in *Captain Jinks*, and made his début, as Max in *Magda*, at Chicago, Ill., in 1903. He toured with William Collier in 1905 and subsequently played light-comedy rôles and melodrama until he appeared in 1916 as Falder in John Galsworthy's *Justice*, which revealed his aptitude for tragic characterization. His notable rôles thereafter were in *Peter Ibbetson*, *The Jest*, *Richard III* and *Hamlet* appearing in the latter rôle at New York in 1924 and at London the following year. In 1926 he began a series of successful performances in motion-pictures.

**BARTAS, GUILLAUME DE SALLUSTE DU** (1544-90), French poet and diplomat, was born at Montfort, Armagnac, in 1544. He visited foreign courts as Henry IV's legate and wrote a poem, *The Week of Creation*, which achieved great popularity, being translated into several languages. Du Bartas died from wounds received at the Battle of Ivry (1590).

**BARTER**, the primitive system whereby goods are directly exchanged, without the assistance of a common standard of value or of a medium of EXCHANGE. For example, if A raises sheep and B raises potatoes, each will desire, in so far as he is not self-supporting, to exchange his surplus for other commodities. Under the barter system A would trade sheep for potatoes, or whatever he desired, and B would trade potatoes for sheep. A would therefore measure the value of all commodities in terms of sheep, B in terms of potatoes. As no common standard exists, these separate systems of evaluation have to be readjusted with each single exchange. If no one desires sheep or potatoes at the time when A or B wishes to trade his surplus, he cannot satisfy his wants. He holds no universally acceptable commodity.

Obviously exchange under these conditions is difficult and complicated. Historically, barter is soon modified by the selection of one commodity as the standard of value. Frequently this measure of value is a commodity, such as cattle or tobacco, which are not easy to exchange. The next step is the choice of some valuable or rare material as a means of exchange. Usually the same commodity eventually becomes both the standard of value and the medium of exchange; society has adopted a MONEY ECONOMY.

E. W. G.

**BARTERED BRIDE, THE**, an opera in three acts by FRIEDRICH SMETANA, libretto by R. Sabina; première (as *Prodana Nevesta*), Prague, 1866, Vienna (as *Die verkaufte Braut*), 1893, New York, 1909. Of his eight Czech operas this is the only one which has made Smetana's name familiar in the operatic repertory.

The heroine of the opera is Marie, daughter of the rich peasants, Kruschina and Kathinka, who has fallen in love with Hans, a servant in her father's household.

Hans's antecedents are shadowy and his fortunes negligible. Marie's parents have therefore arranged for her to marry Wenzel, since Wenzel's father Micha is a wealthy peasant even though the son himself is half-witted. Marie rebels against this arrangement. However, the marriage broker, Kezul, offers Hans 300 crowns if he will clear the matrimonial track for Marie by abandoning her. To this bargain Hans at once agrees upon condition that Marie is made to marry a son of Micha. In despair Marie sees herself destined to marry the half-witted Wenzel, when Hans discloses that he himself is Micha's son by a former marriage, having broken connections with his family because of his stepmother. Since the money will now remain in the family, no objections on either side are offered, and Hans and Marie are duly married.

**BARTHOLDI, FRÉDÉRIC AUGUSTE** (1834-1904), French sculptor, was born at Colmar, Alsace, in 1834. His works are characterized by their colossal scale. The figure of *Liberty Enlightening the World*, at Bedloe's Island, New York Harbor, is 151 feet high. Bartholdi's *Lion of Belfort* is considered his finest work. He died in 1904. See STATUE OF LIBERTY.

**BARTHOLIN, CASPER THOMESON** (1655-1738), son of Thomas Bartholin and grandson of Gaspard Bartholinus, was teacher of anatomy in Copenhagen and made fundamental discoveries, his name being associated with the description of one of the ducts of the sublingual gland and also of the Bartholin's glands, which latter are a portion of the female generative organs.

**BARTHOLIN, THOMAS** (1616-80), a son of Gaspard, was born in Copenhagen. After long study in various European universities he became professor of mathematics in 1647 and of anatomy in 1648, a position he held until he retired in 1661. He distinguished himself by his observations on the lymphatics.

**BARTHOLINUS, GASPARD** (1585-1629), Danish physician, was born at Malmo, Sweden, in 1585. His precocity was such that he could read at the age of three, and composed and delivered in public Greek and Latin orations at the age of thirteen. In 1613 he became professor of medicine in the University of Copenhagen. He became seriously ill in 1624, and he vowed that, should he recover, he would devote himself to divinity. It was thus that he changed his calling, eventually becoming professor of divinity at Copenhagen, and canon of Roskilde. He died July 13, 1629.

**BARTHOLOMEW, ST.**, one of the 12 disciples, mentioned by Matthew, Mark, Luke and in Acts. Both early and modern scholars identify him as Nathaniel, who occurs in the fourth Gospel (John 1:45-49). The name Bartholomew is believed to be merely a patronymic, or family name. Tradition credits St. Bartholomew with missionary visits to India, Ethiopia, Armenia, Mesopotamia and Persia, but of his labors in these countries, and his martyrdom at Aebanopolis, where he was supposedly crucified, there are no records. Churches at Rome and Benevento claim to possess his relics. The saint's

memory is celebrated on June 11 in the Greek Church, but on Aug. 24 in the Roman and Anglican churches.

**BARTHOLOMEW, ST., MASSACRE OF.** The Massacre of Saint Bartholomew began on the saint's day, Aug. 24, in 1572, at Paris, and cost the



COURTESY METROPOLITAN MUSEUM OF ART

SAINT BARTHOLOMEW

From an engraving by Albrecht Dürer

lives of about 50,000 Huguenots or French Protestants. The crime is charged to Catherine de' Medici, wife of Charles IX, who was persuaded that the massacre was necessary to save Catholic France. Once the "authorized" murders began, the street mobs continued the butchery of the Huguenots. The fever spread to the provinces, and the massacre continued until Oct. 3. The French queen received the praises of Catholic officials, and Gregory XIII, misled by reports from Paris, ordered a medal struck off in commemoration.

**BARTLESVILLE**, a city in northeastern Oklahoma, the county seat of Washington Co., situated on the Caney River, 55 mi. north of Tulsa. Bus and truck lines and two railroads afford transportation. There are two private airports. Bartlesville is in the region of extensive gas and oil fields. The chief crops of the vicinity are corn, oats, wheat and vegetables. Important local industries are zinc smelting and the manufacture of oil field equipment, cement and gasoline. The manufactured output, 1927, was worth \$5,778,000. The retail trade, 1929, was valued at \$10,926,891. Bartlesville was founded in 1882; incorporated in 1897. Pop. 1920, 14,417; 1930, 14,763.

**BARTLETT, JOHN** (1820-1905), American editor and compiler, was born at Plymouth, Mass., June 14, 1820. In 1849 he purchased the University Book Store of Cambridge, Mass., which became an informal club for Harvard faculty members, with whom Bartlett, by reason of his phenomenal memory, became a

by-word for classical quotation. In 1855 he published his notebooks of aphorisms, Biblical passages, and prose and verse extracts from the works of American and English authors, as *Bartlett's Familiar Quotations*, which during his lifetime sold nine editions. In 1894 Bartlett published a *Complete Concordance to Shakespeare's Dramatic Works and Poems*. He died at Cambridge, Mass., Dec. 3, 1905.

**BARTLETT, PAUL WAYLAND** (1865-1925), American sculptor, was born at New Haven, Conn., June 4, 1865. He began sculpture as a boy and at the age of 14 exhibited a bust of his grandmother in the Paris Salon. In 1880 he entered the Ecole des Beaux Arts and studied under Cavelier. His principal works are an equestrian statue of Gen. McClellan, Philadelphia; and statues of Gen. Joseph Warren, Boston, Gen. Lafayette, in the Square of the Louvre at Paris, and of Columbus and Michelangelo in the Congressional Library. Bartlett died in Paris, Sept. 20, 1925.

**BARTOLOMMEO DI PAGHOLO, FRA** (c. 1475-1517), Italian painter, known also as Baccio Della Porta, was born in Tuscany, near Florence, probably in 1475. He studied under Cosimo Roselli. Influenced by Savonarola and being deeply affected by his death, Baccio gave up painting after enjoying considerable popularity and entered a Dominican convent in which he remained for 4 years without touching pencil or brush. In 1505 Raphael visited him in Florence and there began between the two a lasting and profitable friendship. From Raphael Bartolommeo learned about perspective and in turn he communicated to him his own principles of coloring. Bartolommeo went to Rome to see the work of his friend and that of Michelangelo. He resumed his painting with new zest, becoming famous for his saints and altar figures. His best painting is perhaps the sublime figure of St. Mark, now in the Pitti Palace, Florence, which has the largest collection of his works. Fra Bartolommeo died at Florence, Oct. 31, 1517.

**BARTON, CLARA** (1821-1912), American philanthropist, organizer of the American Red Cross, was born at Oxford, Mass., Dec. 25, 1821. At the outbreak of the Civil War she entered the army hospital service. During the Franco-German war she assisted the grand-duchess of Baden in establishing hospitals, helped supply food to the destitute in Strassburg in 1871 and distributed food in Paris in 1872. Miss Barton organized the American Red Cross Society in 1881 and was its first president. She headed a relief expedition for Mississippi flood sufferers in 1884 and in 1893 supervised relief for cyclone sufferers on the South Atlantic coast. She died at Glen Echo, Md., April 12, 1912.

**BARTOW**, a city near central Florida, the county seat of Polk Co., about 44 mi. east of Tampa, near Lake Hancock and Lake Polk. Two railroads serve the city. Bartow is in a rich fruit growing and irrigated farming region. There is considerable timber, and large phosphate mines are found near by. The city has many manufactures, including lumber prod-

ucts, cigars, mattresses and phosphates. Pop. 1920, 4,203; 1930, 5,269.

**BARTRAM, JOHN** (1699-1777), American botanist. He founded the first botanical garden in America, and was active in corresponding and exchanging botanical specimens with European naturalists, at one time being the American botanist to King George III of England. Bartram was born in Chester County, Pa., Mar. 23, 1699 and died at Kingsessing, Pa., Sept. 22, 1777.

**BARUCH.** 1. The secretary, disciple and friend of the prophet Jeremiah, who wrote down, at the latter's dictation, the first and second editions of the prophecies of the great prophet (Jeremiah 36). He remained true to the doctrines and preachments of Jeremiah, even at the risk of death on several occasions. Subsequently he was carried to Egypt with Jeremiah. However, other traditions state that he was taken to Babylonia after Nebuchadnezzar's conquest of Egypt. Because of his nearness to and friendship with Jeremiah, later generations extolled him greatly and glorified his reputation. In rabbinical literature especially, Baruch played a prominent part, and many legends grew up about his personality, his identity, and his grave. The Greek and Syriac books, called the Apocalypse of Baruch, which were two books of later times and of Jewish authorship, were ascribed to Baruch in order to gain added authority.

2. One of the important and oft-cited books of the Apocrypha which was alleged to have been composed by Baruch, the disciple of the prophet Jeremiah (Jeremiah 36). Written in Greek, it contains five chapters, and in the Septuagint, it is put between the books of Jeremiah and Lamentations. Actually, however, the Apocryphal book of Baruch was not written until sometime after the Maccabean wars, which occurred between 168 B.C. and 165 B.C.; the time of its composition was probably between 70 and 73 A.D. Its author (or authors) hopes for and promises a speedy return to Palestine. As regards the contents of the book of Baruch: Chapter 1:15 to 3:8 is a prayer of repentance; it is stated that Baruch read this book before the captive King Jehoiachin of Judah and before the people who were assembled around him in Babylonia, and that these captives had sent money as well as Temple utensils to Jerusalem to replace those which had been carried away to Babylonia. Finally, they had prayed that offerings might be brought for themselves, for Nebuchadnezzar, and for his son Belshazzar. Chapter 3:9 to the end is a prophetic address of comfort and admonition to Israel in the land of its enemies, written in the manner of Deutero-Isaiah. Israel, it is stated, has perished because it rejected the wisdom of God as revealed to it in the Torah, or Law. But Israel is yet to take courage, for the exiled ones are one day to return to Jerusalem, which shall once more experience a glorious epoch. There is also a Syriac Apocalypse of Baruch, a pseud-epigraphic work in which Baruch relates his experiences just before and after the destruction of the Temple by the Babylonians in 586 B.C. and tells of

the great revelation which he had received concerning the future of Israel.

3. There are also several books of the Pseudepigrapha which are called Apocalypses of Baruch. The three best-known of these Apocalypses of Baruch are the Syriac, the Greek, and the Ethiopian. These three books represent Baruch, the disciple of Jeremiah, as addressing the people as a prophet in his own name; they thus greatly exaggerate and aggrandize the actual rôle which Baruch had played in Hebrew history. These Apocalypses of Baruch represent the last independent writings of the Jews before the compilation of the Talmud. The favorite motives of the three Apocalypses of Baruch are Messianic ideas and predictions, the rebuilding and subsequent second destruction of Jerusalem, the killing by the Messiah of the last tyrannical rulers of the nation, and the resurrection of the dead, as well as the restoration of the sacrificial and the Temple cult.

A. SH.

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**BARUCH, BERNARD MANNES** (1870- ), American financier, was born in Camden, S.C., April 21, 1870. Appointed to the Advisory Committee of the Council of National Defense by President Wilson in 1916, he later served as a member of the War Industries Board and as a member of the commission in charge of all purchases for the allies. For his advice and services on economics and administration during the world war he received the Distinguished Service Medal from President Wilson and was decorated by France, Belgium and Italy. Baruch is the author of *The Making of Economic and Reparations Sections of the Peace Treaty* and other pamphlets on economics.

**BARYCENTRIC CALCULUS**, the study of geometric figures by means of properties of the center of gravity. Traces of this method are found in the Pappus-Guldin Theorem, first stated in substance by Pappus (c. 300), extended by Kepler (1615), brought into special prominence by Guldin (1641), and further extended by Leibniz (1695) and Euler (1778). L. M. N. Carnot (c. 1800) used the idea in his work in geometry, borrowing it from the field of mechanics. In its simplest form it asserts that the volume of a figure formed, like an anchor ring, by the revolution of a plane figure about an axis is equal to the area of the figure multiplied by the length of the path of its center of gravity.

It was A. F. Möbius (1790-1868) who first systematized the method and developed it as a rigorous discipline with a system of coordinates of its own. In his treatise, *Der barycentrische Calcul* (1827), he made use of points of reference, assuming them to be so weighted that any point whose position is to be determined shall be the center of gravity of the system. These weights are then the coordinates of the point.

For example, let  $P$  be a point on a straight-line segment  $AB$ , and let  $AP : PB = 1 : 3$ . Then 3 and 1, or  $\frac{3}{4}$  and  $\frac{1}{4}$ , are the weights that make  $P$  the center of gravity, and therefore  $\frac{3}{4}$  and  $\frac{1}{4}$  are the coordinates of  $P$ , whose weight is then equal to  $\frac{3}{4} + \frac{1}{4}$ , or 1. The position of  $P$  in a plane is determined by taking three points of reference,  $A$ ,  $B$ , and  $C$ . Assigning to these the respective weights  $a$ ,  $b$ ,  $c$ , that will make  $P$  the center of gravity of the system, these or their propor-

tional numbers  $\frac{a}{a+b+c}$ ,  $\frac{b}{a+b+c}$ , and  $\frac{c}{a+b+c}$  are the coordinates of  $P$  with reference to  $A$ ,  $B$ ,  $C$ . If  $a$ ,  $b$ , and  $c$  are expressed as functions of a variable, then the center of gravity will vary accordingly, every value of the variable yielding a center of gravity for the system.

The locus of these centers will be continuous and will be a straight line if the variable of the function is of the first degree, and a curve of a higher degree if the function is of the corresponding degree. The definition of the center of gravity then leads to the equality  $Aa + Bb + Cc = P(a + b + c)$ . This holds for any axis and makes it possible to develop algebraic equations for curves, thus establishing an analytic geometry based on barycentric coordinates.

J. G.

**BARYE, ANTOINE LOUIS** (1796-1875), French sculptor, was born at Paris, Sept. 24, 1796. He began life as an engraver, goldsmith and topographical engineer, but soon discovered his ability in sculpture and drawing. Barye is the supreme animal sculptor. His work combines a powerful dramatic quality and profound realism of form with a deep knowledge of animal construction and anatomy. Barye died at Paris, June 25, 1875.

**BARYSPHERE**, a term used for the deep, interior portions of the earth which presumably consist of heavy metals or minerals. It is the superheated, very dense and probably molten but inelastic core, estimated at about 2,200 miles in radius. *See also* ASTHENOSPHERE; LITHOSPHERE; STEREOSPHERE.

**BASAL METABOLISM.** *See* DIET AND DIETETICS.

**BASALT**, a heavy, dark volcanic rock of widespread occurrence, often popularly called trap. On fresh fractures the color is gray to black, but purplish and greenish tints are on weathered surfaces. The texture is so fine-grained that the component minerals cannot be identified by the unaided eye, but is not glassy, so that in appearance it is dull, almost velvety. The constituent minerals are plagioclase FELDSPAR, usually labradorite or anorthite, AUGITE, OLIVINE and magnetite. HORNBLende and BIOTITE are rare constituents. The basalts belong to the group of GABBRO, DIABASE and NORITE rocks, but are finer grained because cooled more rapidly near or at the earth's surface.

Basaltic lavas are the most abundant, being extruded now by Etna, Vesuvius and the Hawaiian volcanoes. In recent geological times tremendous outpourings covered an area of 200,000 square miles, in places

thousands of feet deep, in Washington, Oregon and Idaho. The valuable native copper ores of Michigan were deposited later in the amygdules, or almond-shaped cavities, of an ancient series of such flows. The abundant greenstones and pillow lavas of the Canadian Precambrian formations are altered basalts.

When cooling and contracting, intrusive sheets of basaltic LAVA frequently break up into roughly hexagonal columns, a foot or so in diameter and often 150 feet long, always perpendicular to the cooling surfaces. The resulting formations are responsible for such dramatic scenic effects as the Giant's Causeway in Ireland and the Palisades in New Jersey.

Because of its toughness basalt is valuable for paving and macadamizing. *See also* VOLCANO; IGNEOUS ROCKS; BASIC ROCKS; PETROLOGY; DOLERITE; SCORIA; TEPHRITE; TRAP ROCK; FELSITE. S. F. K.

**BAS BLEU** or **BLUESTOCKING**, a term often applied to a literary woman or to a woman who pretends to great learning. It originated in the 18th century when the envious rivals of Mrs. Montagu (1720-80), an English woman of letters, dubbed that lady's *salon* "the Bluestocking Club," in doubtful honor of one of the members, Benjamin Stillingfleet, who liked blue stockings.

**BASCULE BRIDGE**, a type built at low level, having a movable leaf, or leaves, which can be raised to allow boats or ships to pass. The leaves are hinged at the abutments, permitting them to rotate vertically and leave a clear passage-way for tall-masted vessels. Through the use of power, opening and closing can be effected in a few moments' time. *See also* BRIDGES.

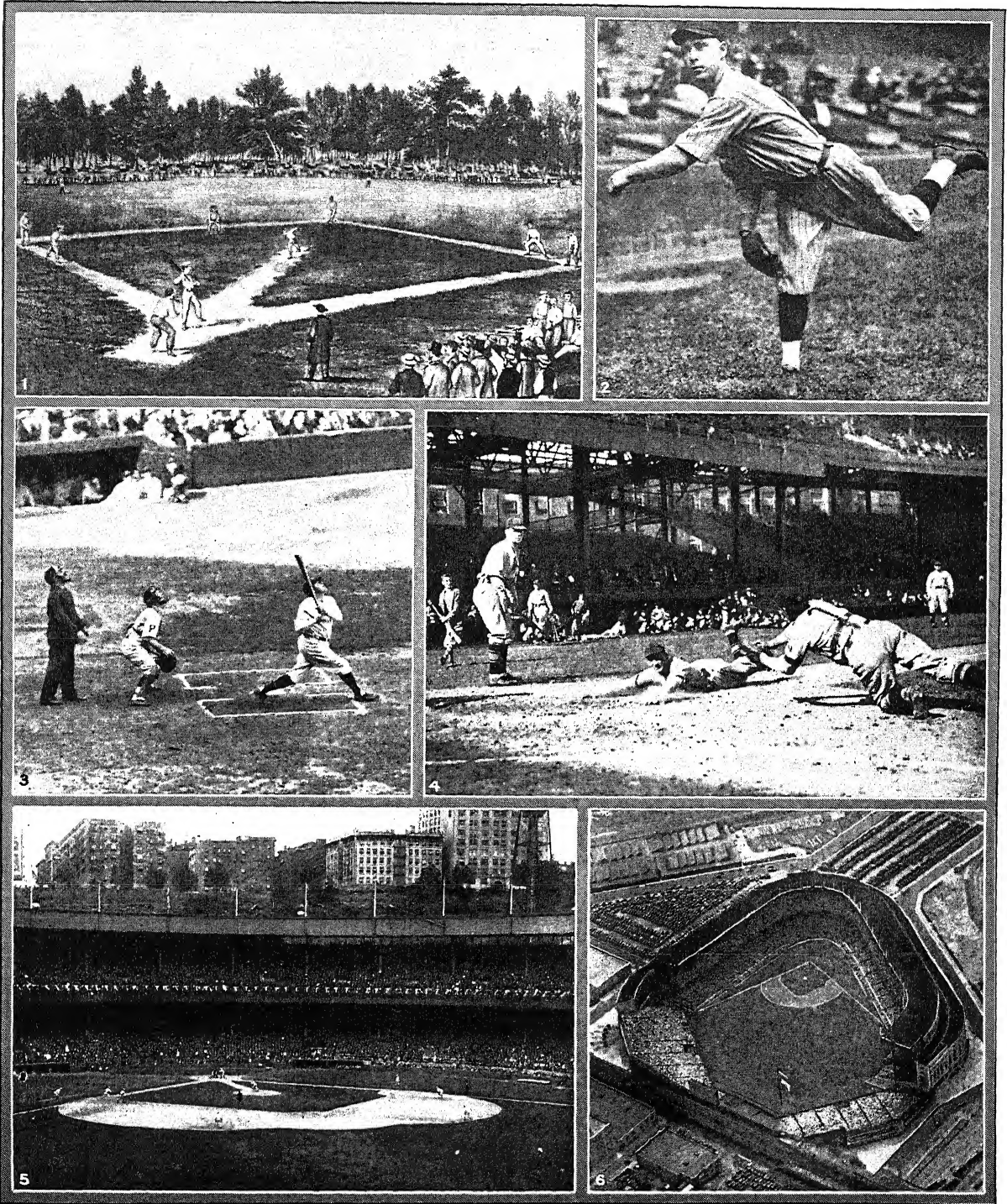
**BASE**, in architecture, the projecting lower exposed part of a column, pier or wall. It serves practically to raise the shaft or wall proper above the ground, or to spread its weight, and decoratively to give a satisfactory bottom finish. Cylindrical simple bases are found under the stone columns of Egypt, and the wooden columns of Ægean and Chinese buildings. The molding and carving of column bases seem to have been first developed in Asia and Asia Minor, probably from Hittite influence. The Greek Ionic order used many types of rich molded base; the most popular later type, known as the Attic Base, consisted of two toruses, or projecting round moldings, with a scotia, or hollow molding, between. Sometimes the whole was set upon a square block or plinth. The Attic Base was much used in Roman work, and furnished the inspiration for most Romanesque and early Gothic bases. In these there was frequently a leaf or grotesque carved to decorate the triangle between the corners of the square plinth and the circular moldings. Late Gothic designers delighted in complicated double or triple bases, intricately molded, and penetrating each other in various ways.

In America the term base, or baseboard, is used for that which in England is termed a sur-base, the board, often with moldings at the top and at the floor, which is used to finish the bottom of a plaster wall.

**BASE**, the complex of sounds from which all members of a given group of cognate words, determinants,



# BASEBALL



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## BASEBALL—THE AMERICAN NATIONAL SPORT

1. Championship match at the Elysian Fields, Hoboken, N.J., when baseball was first a national sport. 2. Sherdel of the Boston National League Team. 3. Babe Ruth, the home-run king, at bat. 4. Marranville of the Boston Braves (National League) sliding in home a split second

ahead of the ball. 5. Section of the Polo Grounds, New York City, with a capacity of 60,000, where the Giants, the National League team, plays. 6. Aerial view of the Yankee Stadium, the American League grounds, New York City, with 66,145 fans in attendance.



or inflectional endings (*see* INFLECTION) may be derived. The meaning of the word-base, which is a purely hypothetical reconstruction, is neither that of a noun or of a verb, but develops into one or the other by inflection (just as English *love* is in itself neither a noun nor a verb unless inflected, as "love of country," "they love virtue"). In INDO-EUROPEAN the base seems to have been either monosyllabic or, much more commonly, dissyllabic; and in SEMITIC to have been either dissyllabic or trisyllabic. Through the operation chiefly of ACCENT, the base underwent apparently complicated, but actually rather simple, vocalic alternations (*see* ALTERNATION, VOCALIC); and by adding determinants, the simple base may be converted into a secondary (and even tertiary, etc.) base. The base is frequently termed the "root," but this appellation is better reserved for the element obviously common to a group of words, as *lov-* (whose base is *leubhei-*, *loubhei-*, *leubhoi-*, *loubhoi-*, as in Sanskrit *lóbha*—"desire," Latin *lubet*, "it pleases") in *love*, *lovable*, *un-love-li-ness*, etc.

**BASE**, a military area, in rear of a field military force which provides facilities for receiving, storing and classifying supplies for a campaign. It is also provided with repair, hospital, supply and other establishments. The commander of the base is responsible for obtaining all the supplies and facilities required. *See also* NAVAL BASES.

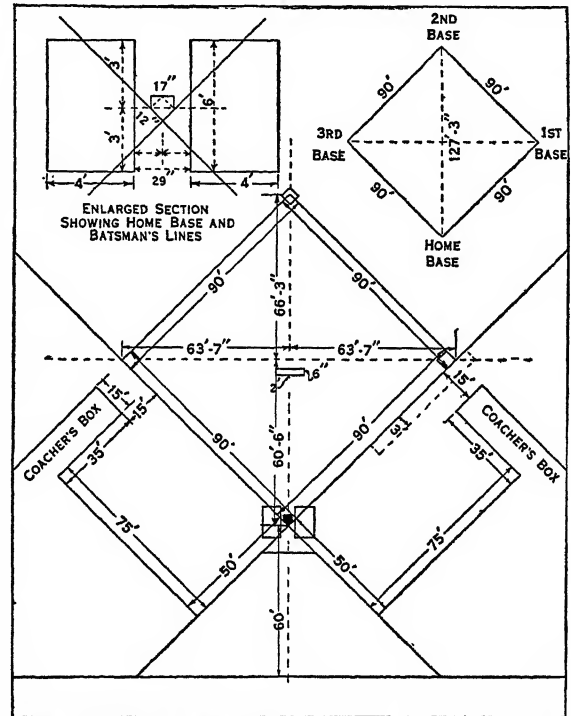
**BASEBALL**, a game of ball played by two teams. It is the national game of the United States. Baseball was invented by Col. Abner Doubleday of the United States Army, who outlined its first diagram and supervised its original contest at Cooperstown, N.Y., in 1839. The field on which this game was played has been turned into a public park in memory of the inventor of baseball. Before the game of baseball was invented games played with a ball and bat were called bat and ball. The new game was christened baseball because of the combination of ball and bases.

A game is played by two teams of nine men, one the team at bat and the other the team in the field. They alternate in half innings as batsmen and fielders and by teams. Substitutes may replace active or regular players. The captain or manager of a team orders such substitution. If a player is permanently retired from a game he may not take part in it again except by the consent of the opposing captain or manager. A player may play in one position for part of a game, another position for an inning or more, and then return to his original position. He must remain actively on the field to permit this changing of place.

Baseball is not a derivation of English rounders, which preceded it in England by many years. It is more an evolution of a simple sport called One Old Cat, Two Old Cat, or Three Old Cat, each name corresponding to the number of players engaged in play. It may have derived some of its methods from a game called town ball, which was played in the United States before baseball was invented. The diagram or field layout for town ball provided for crude bases; stakes were often used. The home plate, the stand

of the batsman in town ball, as it is also his stand in baseball, was located halfway on the base line between first and third bases. Thus the batter stood midway between them.

In the diagram outlined by Col. Doubleday for baseball, the batter takes his position in one of the two rectangular boxes, drawn on either side of the home plate. The pitcher is 60 feet, 6 inches from the home plate on a line drawn toward second base. Each side of the diamond is 90 feet in length, and the bases are located at the angles described by the meeting of these 90-foot lines. Thus the bases are 90 feet apart. Second base is back of the pitcher and straight away from the home plate at a distance of 127 feet,  $3\frac{3}{8}$  inches.



FROM SPALDING'S BASEBALL GUIDE (1931)

OFFICIAL MEASUREMENTS FOR LAYING OUT A BASEBALL FIELD

The base lines, or lines between bases, are marked by powdered chalk, as are also the batters' positions and the position of the pitcher.

The base lines from home plate to first, and from home plate to third, extended to the limit of the extreme outfield are the lines that separate fair territory from foul territory. All of the field within these lines is fair, and all of the field without the lines is foul. The catcher stands back of the batter on foul ground. He receives the ball from the pitcher on a direct throw, and is provided with a mask and a chest protector to avoid injury.

**Adoption of Rules.** For several years baseball had no rules, and games were played under different regulations by the various clubs. This led to much dissatisfaction. The Knickerbocker Club of New York adopted the new diagram, but because of con-



stant dispute over so-called rules decided to write a code. These were so satisfactory that when they were made public, Sept. 23, 1845, they were quickly adopted everywhere. The writing of rules by the Knickerbocker Club was the most important event in baseball after the invention of the diagram for the field. The new rules and the diagram together established the game in the United States. Its spread in the East was very rapid.

In 1857 a convention was called in New York City to form the first national organization. Twenty-five clubs sent delegates. A new national circuit was formed with a membership of 16 clubs. Nearly all were located in New York and Brooklyn. This organization improved the Knickerbocker code of rules. The evolution of plays and increasing speed had made it necessary. From that date baseball became the national game of the country. Great rivalry followed between baseball clubs in New York City and Brooklyn. Games were played on Elysian Field in Hoboken, N.J., ground chosen as neutral territory. Thousands crossed the ferries from New York to see the contests.

As baseball was moving at its swiftest pace the Civil War began. Cities abandoned sports as did isolated sections which were just taking up baseball. The soldiers played baseball in their camps; they reveled in it. There were games between the Federal troops and the Confederates on neutral ground between camps, a truce being declared for the time being. The soldier interest was a principal factor in spreading baseball everywhere in the United States after peace was declared. Soldiers who had been mustered out took the game with them from one ocean to the other.

**Professional Games and Leagues.** Professional baseball first asserted itself in 1868. It began when one, two or three players were engaged for a small sum to try to assist local teams to win important games. From that it spread to the engaging of an entire team to play for money and to represent a certain town or city. In 1869 the Cincinnati team, all professional, under Harry Wright, a famous player, toured all of the United States, winning 81 contests and losing none. In 1871 the first professional league was formed. It declined in two or three years, collapsing because of laxity on the part of players and management; but from that year the United States never has been without a professional organization. Now it has about 20 of them. They are known as major leagues and minor leagues. In 1872 amateur ball players made their first attempt to try to control baseball. They formed an organization which lasted two years and died because the public would not support it, preferring to support professional games with which enthusiasts were better satisfied. That was the last attempt of amateurs to control baseball in a national way.

The first baseball tour to foreign countries was in 1874. Two United States nines visited England to play both baseball and cricket. They left some impress upon the English as to the activity of baseball in

the field, but gained no headway against cricket. The English thought too few runs were made in the United States game. A world's tour was made by two nines under the supervision of the late Albert G. Spalding in 1888-89, and another under the management of Charles A. Comiskey and John J. McGraw in 1913-14. Both of the latter trips included Australia, Egypt and European countries, and both were successful.

In 1876 the National League of Professional Baseball Clubs was formed and is still in existence, the senior baseball organization of the world. In 1900 the American League was formed from the Western League and is the junior major league. Both of these conduct annual championship races from about the middle of April to the first of October. The circuit of the National League is made up of Boston, New York, Brooklyn, Philadelphia, Pittsburgh, Cincinnati, Chicago and St. Louis, and that of the American League consists of Boston, New York, Philadelphia, Washington, Cleveland, Detroit, Chicago and St. Louis. At the end of the league championship season the winners of the pennants in the National League and the American League play with each other in a series of seven games, known as the World Series. The ostensible purpose of this series is to permit the winning championship players to earn a bonus, as they receive a large share of the total gate receipts of the first four games, which is divided among them on a percentage basis. The gross receipts for this series, which began in 1905 under the Brush rules, have been as much as \$1,000,000. Individual players have received more than \$5,000 more than once for winning it.

The minor leagues of the United States are formed into an organization, known as the National Association, with executive officers and a Board of Arbitration which is a governing board for minor league baseball.

Kenesaw Mountain Landis was elected head of all organized baseball, or Baseball Commissioner, in 1920, by the club owners of the major leagues. The Baseball Commissioner is the court of last resort for both the major and minor organizations in case of appeal. It is within his authority to take any action that he deems desirable if he thinks it is for the good of baseball.

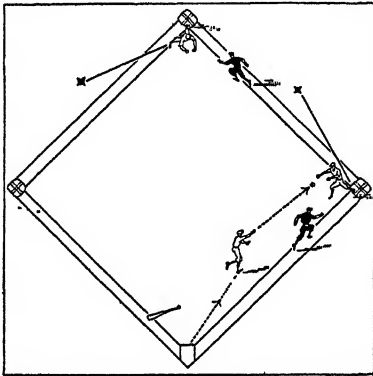
**Rules of Game.** A game of baseball is played with nine active men on each team. Substitutes sit on the bench. The active players are the catcher, pitcher, first baseman, second baseman, shortstop, third baseman, left fielder, center fielder and right fielder. The basemen guard the bases, and the outfielders patrol the territory beyond the bases. The pitcher throws, or pitches, the ball to the batter, who tries to hit it. The catcher receives the ball thrown by the pitcher.

A regulation ball game is of nine innings, each half inning being determined when three batters are put out whether in succession or not. If the score of the game at the end of the eighth inning is in favor of the team that went second to bat, the last half of the ninth inning need not be played. Each team takes its

turn regularly at bat and in the field. When three batters of the team first at bat have been put out, the batting team goes into the field, and the fielding team takes its place at bat, and so it continues until nine innings have been played.

The field on which baseball is played is outlined by chalk to correspond with the diagram invented by Col. Doubleday, to which reference has previously been made. The outfield should extend at least 300 feet from the home plate and further if possible. The center field is almost invariably deeper than the other outfield. The more area there is in the outfield the better opportunity players will have to display their skill.

The rules governing the game, numbering 71, embrace everything from the manner in which put-outs shall be made to all definitions of batting. They govern the pitcher, who must deliver the ball over the home plate at a proper height between knee and shoulder, to be awarded a strike by the umpire, who



COURTESY AMERICAN SPORTS PUBLISHING CO.

A SACRIFICE HIT PLAY

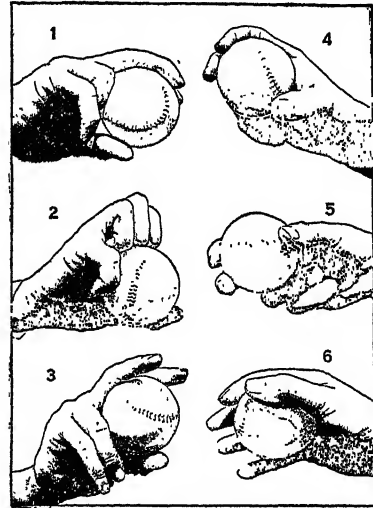
The first baseman is drawn away from his base to field the ball; the second baseman covers first and shortstop covers second. Broken line indicates course of ball. Continuous lines indicate courses of shortstop and second baseman from their positions

is judge of plays. The latter must call a strike when the batter fails to swing at a good ball. If the pitcher fails to get the ball over the plate as the rules stipulate, the batter is given a base on four called balls. These are judged by the umpire behind the bat, who is also called the umpire-in-chief. Most base decisions are given by the field umpire, who usually stands near first base. There may be three or four umpires if the importance of the game demands it.

The batter takes his position at the home plate in a chalk outline rectangle to strike at the ball. He uses a hard wood bat not to exceed 32 inches in length and not more than  $2\frac{3}{4}$  inches in circumference at its thickest part. The ball has a cork center which is surrounded by rubber and yarn. It must not be more than  $5\frac{1}{4}$  ounces avoirdupois and not be less than 9 inches nor more than  $9\frac{1}{4}$  inches in circumference. All leagues use a standard ball.

The game is decided by runs which are made by the batter, who becomes a baserunner immediately upon

leaving the home plate if he is not put out on a fly ball or does not strike out. To make a run, a batter must touch each base in regular order beginning with first base. He cannot score a run in any inning after the third out has been made. There are various des-

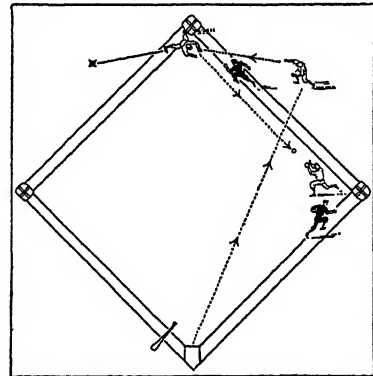


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METHODS OF HOLDING THE BALL

1, screw ball; 2, knuckle ball; 3, fork ball; 4, fast ball; 5, curve ball; 6, slow ball

ignations of the kind of hit that can be made. A hit safe for first base is called a single; a hit for two bases, a two bagger. A hit for three bases is a triple, and a hit which takes the batter to all of the bases in safety is a home run. A ball batted into foul terri-



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A DOUBLE PLAY (SECOND TO SHORT TO FIRST)

The broken line indicates course of ball hit to second baseman, relayed to second, where the shortstop covers bag, and then relayed to first. The continuous line indicates where shortstop left position to cover bag

tory does not entitle the batter to first base. If he bats the ball into fair territory, he must try to go to first base. There are many technicalities in baseball rules which cannot be enumerated in limited space. The baseball rules are printed annually in the Spalding *Baseball Guide*, which is the official rule book of the

National League, and the Reach *Guide* which is the Official Rule Book of the American League. The rules are identical and cannot be changed without the consent of both leagues and with the cooperation of the Commissioner of Baseball, who has sole authority to call a rules committee meeting if revision is considered necessary.

**Outstanding Players and Managers.** To enumerate all the men and players who have been prominent in baseball would require great space. Albert G. Spalding was the best pitcher in the '70s, the period of his playing prime, and the greatest organizer in baseball. George Wright was the best infielder of the '70s and adjudged by some to have been the best infielder of all time. Great batters in baseball have been Adrian C. Anson, Chicago Nationals; Tyrus Raymond Cobb, Detroit; Ed Delahanty, Philadelphia Nationals and Washington; Jesse Burkett, Cleveland; Willie Keeler, Brooklyn; Rogers Hornsby, St. Louis and Chicago; George Herman (Babe) Ruth, New York; John (Hans) Wagner, Pittsburgh; Edward T. Collins, Philadelphia and Chicago; Tris Speaker, Boston and Cleveland.

Cobb played the most games in any one league, 3,033 in the American League. Edward T. Collins, now coach for the Athletics, has played in one league 25 years. J. Everett Scott, shortstop, played in 1,307 consecutive games with the Boston Americans. Cobb in his career made 2,244 runs for the Detroit club. Ruth holds the major league home run record with 60 home runs in one season and a total of 565 in 17 years, not including 1931, in which season he was still an active player.

Denton T. Young, playing with Cleveland, St. Louis and Boston, served 22 years as a pitcher, winning 511 games. Walter E. Johnson pitched 21 years in the American League for the Washington club. Christopher Mathewson, a famous pitcher for the Giants, pitched 56 games during the season of 1908. Edward A. Walsh, Chicago Americans, pitched 66 games for that team in the same year. The record for the most games won in any one season, 60, was made by Charles Radbourne at Providence in 1884. Mathewson holds the National League record for winning the most games in one season, with a total of 37 in 1908. Johnson of Washington pitched 56 innings in 1913 without a run being scored against him. The first no hit game was pitched by Joseph E. Borden in 1875. A no hit game is one in which no batter of the opposing team makes a safe drive. In 1880 John Lee Richmond pitched what is called a perfect game, no player making a hit or reaching first base in any way. Denton T. Young, previously referred to, pitched a perfect game in 1904.

The leading managers from the standpoint of winning championships have been Connie Mack, manager of the Philadelphia Americans; John J. McGraw, manager of the New York Nationals; Albert G. Spalding, manager of the Chicago Nationals in early days; Miller Huggins, now deceased, former manager of the New York Americans. The Chicago Nationals won

five championships under Spalding; the New York Nationals, 10 under McGraw, and the Philadelphia Americans, eight under Mack.

J. B. F.

**BASEDOW, JOHANN BEREND** or **BERNHARD** (1723-90), German teacher and educational reformer, was born at Hamburg, Sept. 11, 1723. In 1753 he was appointed master of the academy at Soroe. Eight years later he was removed from the gymnasium at Altona for heterodox opinions derived from Rousseau. Princes and other nobles contributed about \$10,855 for the publication of his *Elementar Werk* which contained 100 copper plates by Chodowiecki. Basedow's numerous philosophical and educational works awakened public attention to the heretofore neglected subject of education. His influence on the public mind of his age, especially in Germany, was great. He died at Magdeburg, July 25, 1790.

**BASEL, BASLE** or **BÂLE**, a city of Switzerland, capital of the half-canton of Basel-City, on both banks of the Rhine where it turns northward. It is near the Roman colony Augusta Raurica, which was founded in 27 B.C. In medieval times Basel was a free imperial city. Pope Pius II founded a university there in 1460, and since 1501 it has been a member of the Swiss Confederation. Since the demolition of the fortifications promenades surround the old part of the city. Noteworthy features are the minster, a cathedral until about 1528, the historical museum, once a monastic church of the 14th century, the Rathaus, built in 1508, the great art gallery with many pictures by H. Holbein the Younger, fountains and monuments. The silk industry is the most important, but there are also factories producing woolen goods, paper, chemicals, clocks and watches. More than half of the Swiss exports pass through Basel. It is the seat of the BANK FOR INTERNATIONAL SETTLEMENTS, founded in 1930. Pop. 1930, 147,198.

**BASE LINE**, in surveying, that side of one of the basic triangles whose length is measured directly with tape or other apparatus. *See also* SURVEYING. The lengths of all other sides are found by trigonometric computation by means of the measured horizontal angles. Also, a term applied by some engineers to the principal traverse run through a region in which engineering construction is contemplated, such, for example, as the "traverse" following the proposed line of a sewer and from which all buildings and property lines are located. The term "base" is occasionally applied to the datum for levels as, for instance, "Boston base," which has a certain relation to the elevation of mean low water at Boston Navy Yard. *See also* BENCH-MARK.

**BASES**, in chemistry, most commonly substances that undergo electrolytic dissociation (*see* ELECTROLYSIS) in aqueous solution with the liberation of hydroxyl ions. Chemists are now, however, generally inclined to favor the more general definition that any substance capable of combining chemically with protons (hydrogen ions) is a base. *See also* ALKALI.

**BASHI-BAZOUKS**, a sort of irregular, mounted, Turkish militiamen who achieved particular notoriety

in the 19th century. Though armed and commissioned by the sultan's government, they received no pay and wore no special uniform. In general, the Bashi-Bazouks were exceptionally powerful and healthy men, armed with antiquated rifles and with a bizarre variety of huge knives and swords which were stuck into or dangled from ostentatious, if often badly worn, belts. Their name, meaning literally "reckless fellows," is descriptive of their bravery and of their ruthlessness. Occasionally they became so unruly as to require disarming by the regular troops. They lived primarily on plunder, and were especially useful on outpost and reconnaissance duty. Sometimes, too, they were utilized as a gendarmerie. Perhaps the most infamous of their misdeeds was the perpetration, under the leadership of Achmed Agha, of the so-called "Bulgarian Atrocities" in 1876.

**BASHKIRTSEFF, MARIA CONSTANTINOVA** (1860-84), Russian artist and diarist, was born at Gavrontsi, South Russia, in Nov. 1860. She studied music and painting in Paris in 1877 but poor health prevented her from developing the artistic talent evident in her few pictures. She is best known for her remarkable autobiographical journal published in 1890 as the *Journal de Marie Bashkirtseff*. She died in Paris, Oct. 31, 1884.

**BASIC ROCKS**, that group of IGNEOUS ROCKS containing less than 66% of silica. QUARTZ is usually absent and the rocks are characterized by large amounts of the dark, ferromagnesian minerals or silicates of iron and magnesium. They are therefore usually dark in color. DIORITE, GABBRO, their fine-grained equivalents, ANDESITE and BASALT, with pyroxenite and PERIDOTITE, are the principal basic rocks. See also ACID ROCKS; PETROLOGY.

**BASIC SALTS**, substances resulting from the partial neutralization of poly-acidic bases by acids. This nomenclature arises out of the older and as yet more commonly used definition of BASES, namely that they are substances which liberate hydroxyl ions in aqueous solution. Thus, in basic lead nitrate,  $Pb(OH)NO_3$ , one hydroxyl ion of the weak base,  $Pb(OH)_2$ , has been replaced by the nitrate ion.

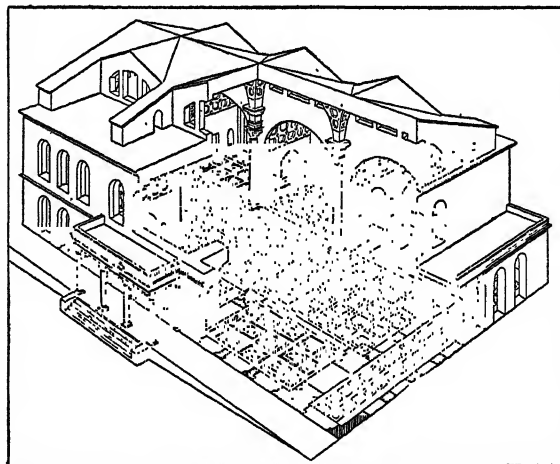
**BASIL** (329-379), one of the fathers of the Greek church, surnamed "The Great," was born at Caesarea, in Cappadocia, 329. His anniversary is celebrated in the Greek church Jan. 1, and in the Latin church on the 14th of June. Basil is honored as a saint in the Greek and other oriental churches. His rules of monastic life are followed in the Greek church and in certain Roman Catholic religious communities. He died at Cappadocia Jan. 1, 379.

**BASIL** (*Ocimum Basilicum*), a fragrant annual of the MINT family, with purplish foliage and flowers, native to tropical Asia and Africa and cultivated for seasoning, especially in France. The wood of the holy basil (*O. suave*), of India, is made into rosaries. In the United States the name basil is applied to various native mints.

**BASILIAN MONKS**, a name quite generally applied to the monks of the Orthodox Eastern Church

because their monastic rule is attributed to St. Basil the Great, Bishop of Caesarea from 370-379, who about the year 360 was a monk near Neocaesarea in Pontus. Prior to his day the prevailing form of monachism was eremitical; the monks were solitaries, whose lives were characterized by extreme physical asceticism. St. Basil's Rule marked a departure from the eremitical ideal to the cenobitic, or from solitaries to groups of monks living in a community a life of renunciation, combined with active labor. The eremitical ideal still survives, however, in Eastern monachism. Preaching and charitable work as a part of the monastic life have been largely abandoned by the Basilian monks, who devote the greater part of their time to prayer and religious services. Their life is sternly ascetic, particularly in such matters as fasting. The well-known monks of Mt. Athos in Greece are Basilians. A chief influence of Basilian monachism on the Orthodox Church to-day arises from the fact that, while the parish clergy include men married before their ordination, the bishops, who must be unmarried, are largely drawn from the monasteries. Roman Catholic communities of Basilians were also established in Italy and Spain. A teaching order of Basilians, founded in France soon after the Revolution, has houses in England, Canada and the United States.

**BASILICA**, a word applied by the Romans to a covered building for civic use, especially for one used as a court house. Later, with the adoption of that form of building for churches by the early Christians, the word came to be used for church buildings of a specific type with nave, aisles, clerestory, apse and sometimes transepts. Occasionally the word is loosely used for any church building.



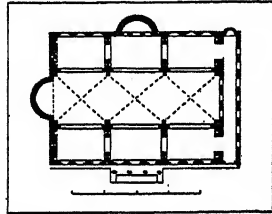
CHRISTIAN HUELSEN, THE ROMAN FORUM AND THE PALATINE.  
G. E. STECHERT & CO

RESTORATION OF THE BASILICA OF CONSTANTINE, ROME

The Roman basilicas usually consisted of a large central area, the nave, surrounded by aisles or galleries in one or two stories. The roof was usually a flat timber roof, as in the Basilica Æmilia, of the time of Tiberius, the Basilica Julia, 46 B.C., and the Ulpian

Basilica, built by Trajan, at Rome. But in the basilica of Maxentius and Constantine, the type of groined-vaulted construction developed in the great halls of the Roman baths was adopted for basilica use. At one end, sometimes at both ends, there was a recess, reserved for the judges, with a raised floor, and often apsidal in shape. The judges' recess of the basilica in Pompeii, 2nd century B.C., was rectangular. In the average Roman basilica the nave and aisles were separated by columns; in the Basilica Julia, however, due to the use of groined vaults in the aisles, piers decorated with pilasters and carrying arches were used. Vitruvius, in the Augustan age, gave a full description, still extant, of a basilica designed by him for the town of Fano. The existing pagan Roman room which most nearly approximates the scheme of the later churches is the so-called basilica in the Palace of Domitian on the Palatine hill at Rome. In this the nave, aisles and apse are all present.

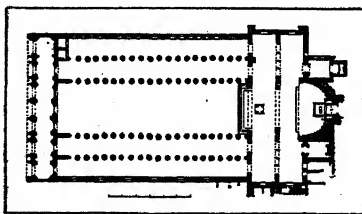
The Constantinian basilicas at Rome, old St. Peter's, St. Paul's Outside the Walls, rebuilt in the 19th century after a fire, and St. John Lateran, much altered, all show the complete development of the Christian basilica. The nave is very wide, and the apse is the full width of the nave. In St. Peter's and St. Paul's Outside the Walls there are double side aisles on each side, a transept, a complete clerestory in the nave above the aisle roofs, and across



FROM A. D. F. HAMLIN, A HISTORY OF ARCHITECTURE, LONGMANS, GREEN

PLAN OF BASILICA OF CONSTANTINE, ROME

the front runs a narthex, or porch. The ceilings are richly coffered in wood and gilded; the floors are of large slabs of variegated marble. Glass mosaics on a gold ground of Byzantine type decorate not only the apse dome, but also the triumphal arches between the apse and transept and the transept and nave, and the



FROM A. D. F. HAMLIN, A HISTORY OF ARCHITECTURE, LONGMANS, GREEN

PLAN OF THE BASILICA OF ST. PAUL'S OUTSIDE THE WALLS, ROME

higher walls of the nave as well. In some of the early basilicas, the columns between the nave and aisles carry a simple entablature, as in Santa Maria Maggiore, 432-440, San Lorenzo fuori le Mura, 6th century, and Santa Maria in Trastevere, 4th century, rebuilt in the 12th century. In others, the columns carry arches directly upon the capitals as in St. Paul's Outside the Walls and the old St. Peter's.

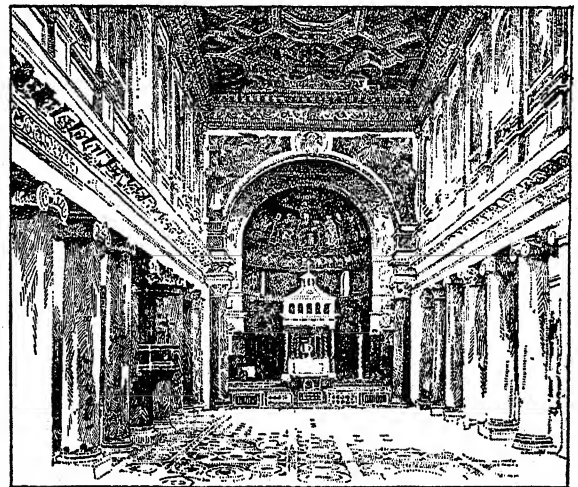
These Constantinian basilicas in Rome exerted a

great influence throughout Christendom, except where the direct power of Constantinople was felt. In the 6th century, the churches of San Apollinari Nuovo and San Apollinari in Classe in Ravenna were purely



SANTA MARIA IN TRASTEVERE, ROME  
*Begun in 1139*

basilican in plan and structure. In Salonika, the great church of St. Demetrius was basilican in plan despite its byzantinesque decoration, and the greater number of the earliest Gallic churches were of the same type.



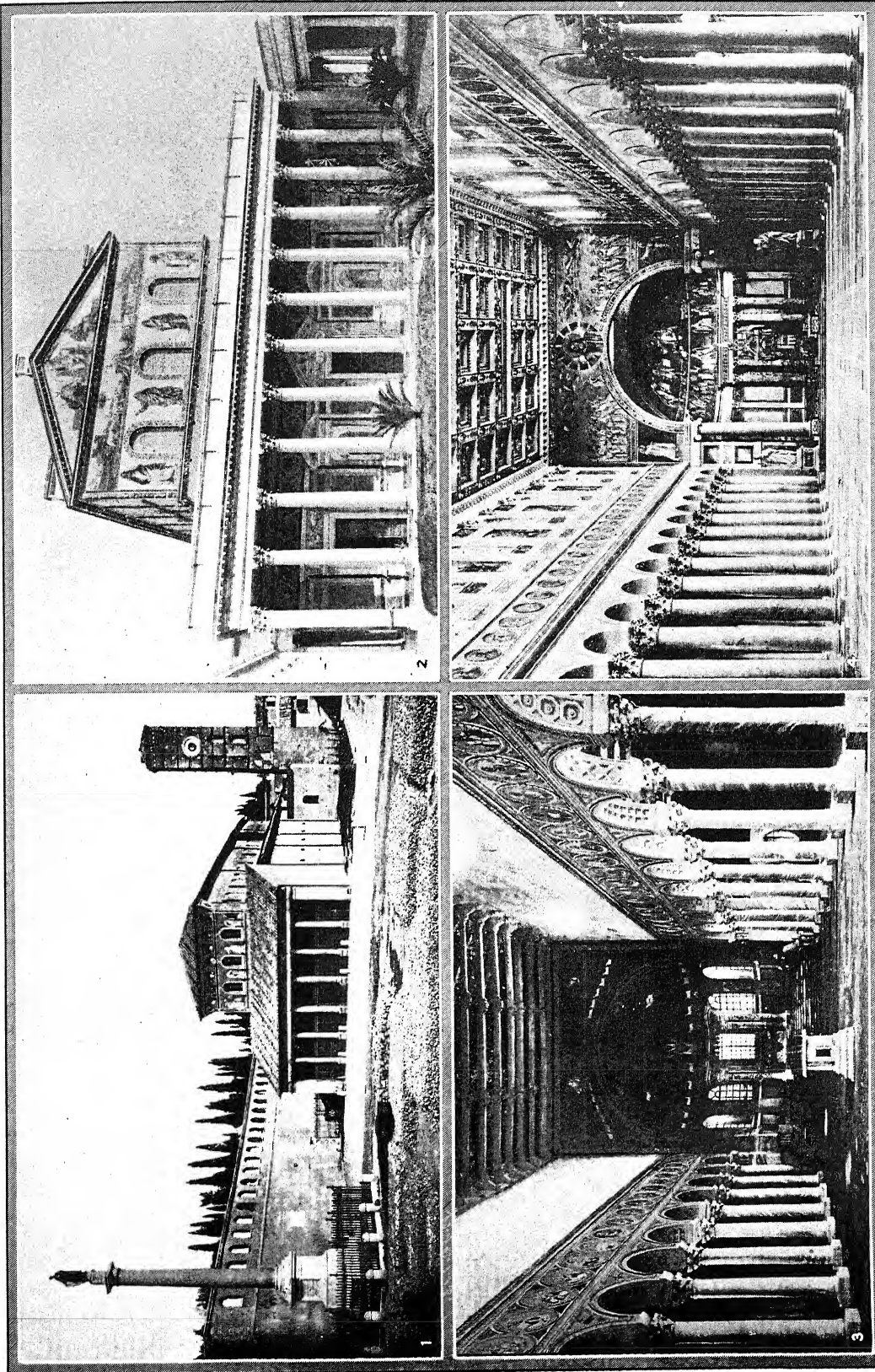
INTERIOR OF SANTA MARIA IN TRASTEVERE, ROME  
*Showing nave, choir and apse*

ROMANESQUE ARCHITECTURE is largely the history of the attempt to produce fireproof vaulted churches of basilican plan. The success of this attempt led directly to the development of the Gothic cathedral, which was also basilican.

**Furniture.** Old St. Peter's had a screen of columns across the apse; and some kind of separation between congregation and clergy became universal. From the 8th century on, this was accomplished by surrounding a space in the nave with marble railings,



# BASILICA



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## BASILICAS OF ITALIAN CITIES

1. San Lorenzo fuori le Mura, Rome. 330 A.D. (façade and tower of a later date). 2. Chief façade and portico of St. Paul's Outside the Walls, Rome, founded 386, but rebuilt after a fire in the early 19th century. The mosaics in the upper part represent Christ with St. Peter and St. Paul and the four great prophets.
3. Interior of Sant' Apollinare in Classe fuori, Ravenna, erected during 535-538. 4. Interior of St. Paul's Outside the Walls, showing the chancel arch surrounded by mosaics representing Christ and the 24 Elders of the Revelation.



Naturally enough, since the game was developed in a training school for Y.M.C.A. physical directors, it spread very rapidly to all parts of the world among the members of this organization. The Y.M.C.A. teams were the outstanding and most highly developed in the early period of the game. Yale, Cornell and the University of Chicago are reported to have had representative teams in 1893. In 1901 Princeton, Yale, Harvard, Columbia and Cornell met and organized

The diagram illustrates the layout of a basketball court with the following dimensions and features:

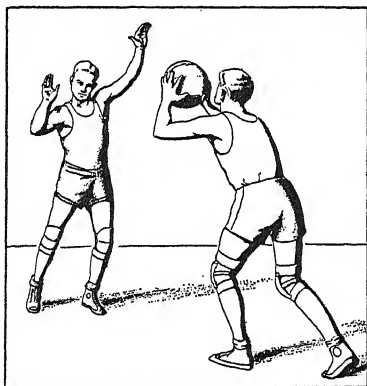
- Overall Dimensions:** The court is 23 feet wide and 29 feet long.
- Key Areas:**
  - Backboard:** Located at the top of the key, measuring 2 feet wide and 4 feet high.
  - Free Throw Line:** A line 15 feet from the backboard, defining the **FREE THROW LANE**.
  - Center Circle:** A circle with a 2-foot radius, centered in the court.
  - Three-Point Arc:** A semi-circle with a 6-foot radius, defining the **FREE THROW LANE** and the **FREE THROW LANE**.
  - Basket:** Located at the bottom of the key, 15 feet from the side line and 17 feet from the free throw line.
- Guard Areas:** The **LEFT GUARD** and **RIGHT GUARD** areas are the regions outside the key.
- Other Labels:** **LEFT FORWARD**, **RIGHT FORWARD**, **END**, and **LINE** are also indicated.

DIAGRAM OF A BASKETBALL COURT.

The object of basketball is to score as many points as possible by tossing the ball into the opponents' basket (goal) and at the same time to prevent the other



team from scoring. The court, which must not be over 94 x 50 feet and not less than 60 x 35, is enclosed by well-defined lines, and is marked off by a circle in the center and free throw lines and lanes at each end. Aside from the court the other equipment necessary is a ball, two bank boards and a pair of baskets. The ball is made of a rubber bladder covered with a leather case, not less than 30 nor more than 31 inches in circumference and must weigh not less than 20 or more than 22 ounces. The bank boards are six feet wide and four feet high and are made of wood, metal or glass painted white. The face of the bank is set in two feet from the end line and should be equal distances from the side lines. The baskets consist of a metal rim, inside diameter to be 18 inches, suspended from which are nets of white twine. These baskets are attached to the face of the banks, the top surface of the rim to be 10 feet from the floor. The team is composed of two forwards, a center, and two guards. The game is started by the referee who tosses the ball up between the two opposing centers in the middle of the floor. Each attempts to bat the ball to one of his team-mates. The side securing it immediately endeavors by a series of passes or dribbles to advance the ball near enough to the opponent's goal to make a successful shot. The team failing to secure the ball attempts to prevent the opponent from making a goal, and at the same time tries to get possession of the ball,



COURTESY "SPALDING'S BASKETBALL"

PREVENTING A BASKET THROW

by interception or recovering on a missed shot or through an opponent's misplay, after which it becomes the attacking side. When a member of one team causes the ball to go out of bounds, it is returned into the court by a member of the opposing team, who, bringing it to the point where it left the court, may pass it in any direction to any one of his team-mates. The player having possession of the ball may neither run with it nor kick it, but must advance the ball by passing, dribbling or shooting. The player guarding him may not tackle, trip, shove, or use any method that is unnecessarily rough with the opponent, but must secure the ball by intercepting a pass or taking it from an opponent without coming in bodily contact with him. Violation of any of the rules constitutes

a foul. When a goal is scored from the field two points are scored; when made from the foul-line in what is known as a "free throw," one point. The actual playing time consists of two 20 minute halves. The visiting team has its choice of goals, which are exchanged at the end of the first half. The officials are a referee, one or two umpires, two time-keepers and two scorers.

E. J. T.

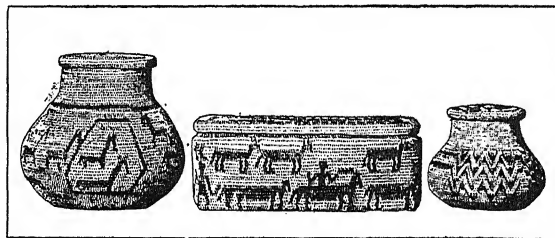
**BASKET-FLOWER** (*Centaurea americana*), a smooth stout annual of the composite family found growing wild from Missouri to Louisiana and Mexico, and often cultivated for its showy heads of rose-colored or purple flowers. The flower-head, sometimes 5 in. across, is borne at the top of an erect stem 1 to 5 ft. tall.



P. A. RYDBERG "FLORA OF PRAIRIES AND PLAINS"

BASKET-FLOWER

**BASKETRY**, one of the oldest and most valuable of the crafts and one which has had practically universal development among all peoples in all times wherever the materials were obtainable. For uncivilized people, basketry furnishes innumerable essential articles. Its principal use is for articles for carrying purposes, but it is also used for fences, weirs, houses, clothing, cradles, stools, screens, cooking and water vessels, canoes, helmets and shields, and for ceremonial articles and the disposal of the dead. Characteristic materials used are palm fronds in the tropics; willows, reeds, bark, grasses and pine needles in the temperate zones, bamboo in China and Japan, khus-khus grass in India and roots of evergreens in the interior of Alaska. Types of basketry come under the general heads of plaiting, weaving of two sets of parallel strips over and under each other in various combinations, and coiling, in



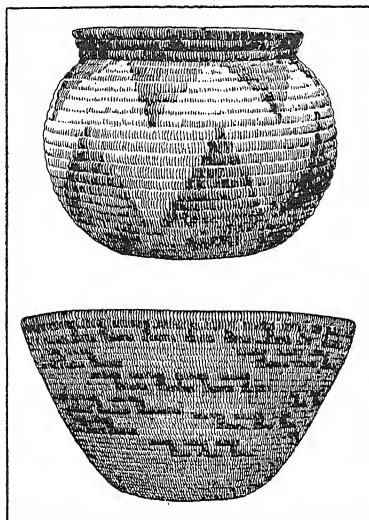
COURTESY AMER. MUS. OF NATL. HISTORY

BASKETS FROM BAROTSELAND, AFRICA

which the article is built up spirally by binder stitching or lacing two or more rods or fibers together by means of strips of bark, root or wood. Patterns and decorative designs are obtained by varying the weaving, by using different materials and by the introduction of dyed grasses and reeds. The Tlingit Indians of southern Alaska are famous for their superb basketry

as are also the Pomo Indians of southern California and the Hopi of northeastern Arizona.

**BASQUE** or **EUSKARA**, a language spoken in the Spanish provinces of Guipúzcoa and in parts of those of Vizcaya, Alava, and Navarra, as well as in



COURTESY AMER. MUS. OF NATL. HISTORY

BASKETS MADE BY MISSION INDIANS OF CALIFORNIA

the French *arrondissements* of Bayonne and Mauléon. The number of speakers is uncertain, but scarcely exceeds 800,000. It falls into a large number of dialects divided between Western (Biscayan) and Eastern (Guipúzcoan), distinguished chiefly by peculiarities in the conjugation of the verb. Basque is marked



COURTESY AMER. MUS. OF NATL. HISTORY

BASKETWORK OF THE INDIANS OF THE SOUTHWEST

Left, Jicarilla water basket. Center, San Carlos Apache burden basket. Right, San Carlos Apache storage basket

by an unusually rich phonetic system both in vowels and in consonants, by lack of grammatical GENDER, by a post-fixed ARTICLE, by a predominantly "progressive" verbal inflection (cf. English "I am going") which differs according to whether the verb is transitive or intransitive, by a word-order which puts the most important element first, by absence of a direct object ("by the man is seen the dog" = "the man sees

the dog") except with pronouns, and by a highly complicated syntax. It is generally agreed that Basque is descended from ancient IBERIAN, but its further linguistic affinities are disputed, the most plausible hypothesis being that of connection with CAUCASIAN.

Basque literature begins with a collection of poems (Bordeaux, 1545), and consisted, until 1880, mainly of translations of religious works. Since that time, the number of original compositions in all fields has steadily increased; and there is also a wealth of oral poems, stories and dramas both serious and farcical.

L. H. G.

**BIBLIOGRAPHY.**—W. J. van Eys, *Grammaire comparée des dialectes basques*, 1879, and *Outlines of Basque Grammar*, 1883; A. Campion, *Gramática de los cuatro dialectos literarios de la lengua euskara*, 1884.

**BASQUE PROVINCES**, the regional name of the three provinces in Spain of Vizcaya, Guipúzcoa and Alava, in the north central part of the peninsula, comprising an area of 2,739 sq. mi. Vizcaya, of which the capital and principal city is BILBOA, and Guipúzcoa, of which San Sebastian is the capital, are coastal provinces, bounded on the north by the Bay of Biscay. Vitoria is the capital of Alava, which lies south of Vizcaya. Combined population of the three Basque Provinces, 1928, 839,600.

**BASQUES**, the modern representatives of an ancient people dwelling in the Iberian Peninsula and southern Gaul, now native to the three Basque provinces of Alava, Vizcaya and Guipuzcoa (2,739 sq. mi.) in north central Spain, and to the three cantons, Labourd, Basse-Navarre and Soule, in southwestern France. In 1153 the Basques on the north side of the Pyrenees were annexed to France; but the Spanish Basques have maintained their group integrity in the face of the vanishing ethnological characteristics of the border races of modern Europe. The Basque language, unrelated to the Indo-European language family, and a highly individualized social code have been preserved by the Basques despite the political affiliations of the provinces with Spain since 1370, when the Spanish Basques were united to Castile. In 1906 the Basque provinces achieved partial autonomy under Spanish sovereignty, and, in exchange for provincial self-government and the right to collect their own taxes, the Basques agreed to pay the state an increasing yearly tribute. This amounted to 40,000,000 pesetas in 1931. In Apr. 1931, following the abdication of King Alfonso, the Basques repudiated their political and financial agreement with the former monarchy.

**BASRA**, a city and port of Iraq, situated about 60 mi. up the Shat-el-Arab River from the Persian Gulf. It is the only port in Iraq accessible to ocean steamers. It also lies on the Europe-to-India air route. Basra dates are regarded as the finest in the world. Besides dates, the city exports wool, horses and licorice. It has an unpleasant climate and is rendered unhealthy by nearby marshes and the poor sanitation system, but is growing rapidly in population and prosperity. Est. pop. 1928, 50,000.

**BAS-RELIEF**, or low-relief, a type of relief sculpture in which the design is but slightly raised from the level of the background. It suggests pictorial effects and is a nice problem in projection. The sculptor has to produce an illusion of three dimensions through practically a two-dimensional medium. This is achieved by skillful superposition of planes. Forms to stand out from the ground are well defined, while those suggesting distance are subtly indicated by a blending into the ground.



COURTESY M. M. OF ART

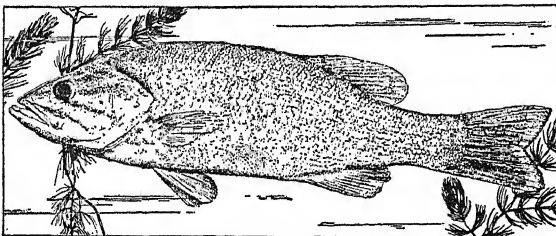
GREEK BAS-RELIEF OF A YOUNG HORSEMAN (4TH CENTURY B.C.)

**BASS**, in music, the name of the lowest male voice having the average compass from E to d' (see OCTAVE for an explanation of this nomenclature). In exceptional cases the range extends downward to C or

even, among a few Russian singers, to A, in such instances being known as *basso profundo*. In **HARMONY** bass is the name of the lowest tone in a chord, being identical with the root when the cord is in **FUNDAMENTAL POSITION**. Figures placed beneath the bass indicate the intervals to be sounded above it, and thus constitute a species of musical shorthand known variously as figured bass, thorough-bass, and *basso continuo*.

**BASS**, a name given to various food and game fishes. In the eastern United States it is applied especially to the black basses (*Micropterus* sp.), somewhat perchlike fishes closely allied to the sunfishes (*Centrarchidae*). but of greater size, more elongate form and more voracious habits.

The most highly esteemed species, the small-mouthed black bass (*M. dolomieu*), is dull green



SMALL-MOUTHED BLACK BASS

in color with a golden luster, growing usually from 1 to 2 ft. long and attaining a weight of 5 lbs. It is native to clear cool streams and lakes from northern New York to Manitoba and southward to South Carolina and Arkansas, and widely introduced into other regions. This remarkably active species is one of the pluckiest American game fishes. The large-mouthed black bass (*M. floridanus*), dark green above and silvery below, reaching a length of 30 in. and an extreme weight of 20 lbs., is common in sluggish

waters from the Great Lakes to North Dakota and southward to Florida and Mexico. While not so active or courageous as the first named species, the large-mouthed black bass ranks as a good game fish and is known by many other names, as Oswego bass, green bass, bayou bass, and river bass.

The calico bass (*Pomoxis sparoides*), closely allied to the CRAPPIE, is a beautiful fish about a foot long, silvery olive in color with green and black mottlings. It is common in ponds and slow streams in the eastern United States.

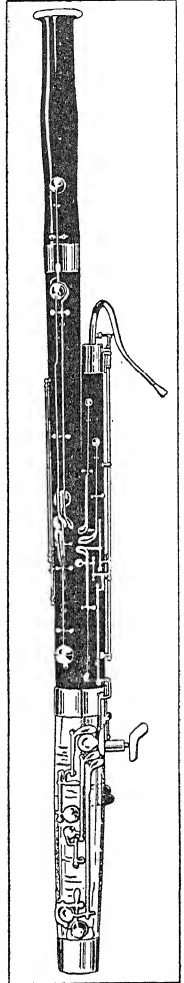
Certain fresh-water members of the sea-bass group are commonly known as bass, as the striped bass (*Roccus lineatus*), a fine food and game fish of the Atlantic coast which enters the mouths of rivers to spawn. A few members of the sea-bass group live entirely in fresh water. Among these are the white bass, a handsome silvery fish sometimes 18 in. long, abundant in deep waters in the north central states, and the yellow bass (*Morone interrupta*), similar in size but brassy yellow in color marked with black lines, common in the lower Mississippi valley. A. B. J.

**BASS DRUM**, a percussion orchestral instrument; see **DRUM**.

**BASS FISHING**. See **ANGLING**.

**BASSINET**, a basket with a hood over one end, used as a child's cradle or as part of a perambulator; also a basket for an infant's outfit.

**BASSOON**, a musical instrument forming the bass of the wood-wind section of the modern **ORCHESTRA**, save when the double-bassoon or contra-bassoon, having a lower register, is used. Its tone is roughly that of a bass oboe. In its physical aspect it is a conical wooden pipe about 4 feet in length and is equipped with a double reed. Known in Italy as the fagotto (literally, bundle of sticks), because part of the pipe is doubled back on itself, it nevertheless has only a distant relationship to the phagotus invented about 1540 by the canon of Ferrara, Afranio, and a common identification of the two instruments is erroneous. The bassoon is properly a developed form of the sixteenth-century bass-pommer which was a member of the schalmey family of wind instruments to which the oboe belonged. It came into general use in the 17th century, and since then has acquired increasing importance. Its compass extends down to B, flat and up three octaves to b' flat or even to e'' flat (see **OCTAVE** for an explanation of this terminology). Reference to the "loud bassoon" in the *Ancient Mariner* is misleading, for the normal tone of



BASSOON

the bassoon is far from strident, inclining much more to the guttural; it nevertheless is capable of producing a tone of fair volume, while its timbre, although blending admirably with both oboe and clarinet in ensemble, remains distinctive and excellently suited to solo purposes. Mozart wrote a concerto for the instrument, and there is scarcely a single orchestral score which is not enriched by its independent activities.

**BASSO OSTINATO**, in music, a phrase which occurs in the bass and is constantly repeated while a variety of harmonies is built upon it. It is known also as a ground bass, and characterizes certain types of composition such as the *PASSACAGLIA*.

**BASS ROCK**, an island in Haddingtonshire, Scotland, situated in the Firth of Forth, about 3 mi. north-east of North Berwick. A volcanic formation, about 1 mi. in circumference and 350 ft. high, it is partially penetrated by a tunnel, and is high-cliffed except on the southwestern side. There is a powerful lighthouse. After 1671 the island was a prison for Covenanters. It was held by the Jacobites in the latter part of the 17th century. Bass Rock belongs to descendants of Sir Hew Dalrymple.

**BASSWOOD**, the name commonly applied in North America to the native species of *LINDEN* (*Tilia*), sometimes called also lime tree and whitewood. According to C. S. Sargent, there are 15 species, natives chiefly of the southeastern states. The common basswood or American linden (*T. glabra*), of more northern range than the other species, is found from New Brunswick to Saskatchewan southward to Kentucky and Nebraska. It grows usually 60 to 70 ft. high, but sometimes reaches a height of 130 ft. with a tall trunk 4 ft. in diameter. Various basswoods are planted for ornament and basswood honey is unsurpassed in flavor. Basswood lumber, marketed under the name of whitewood, is highly prized for wooden ware. In 1927 the total cut in the United States amounted to 145,601,000 bd. ft. valued at the mill at \$5,800,743.

**BAST**, a plant tissue composed of relatively long, narrow, flexible, tough cells called bast fibers or bast cells found in the strong inner fibrous bark of various trees and in the fibro-vascular bundles of herbaceous plants. Textile fibers obtained from plant bark, as flax, hemp, ramie and jute, are composed chiefly of bast cells. The tough bast fibers of the basswood or linden (*Tilia*) and other trees are frequently manufactured into cords, mats and the like.

**BASTARNAE**, a Germanic people with some Celtic and Sarmatian elements. As early as 200 B.C. they are mentioned as dwelling on the lower Danube. From time to time they were allied with enemies of Rome, such as Philip V of Macedon, Perseus, and Mithradates. In 29 B.C. they were defeated by Crassus. Marcus Aurelius imposed a special tax in the East in connection with an incursion of Bastarnae into Asia Minor. They seem ultimately to have merged with the Goths.

**BASTIA**, the commercial metropolis and chief military station of Corsica, situated on the east coast of

the island. Founded by the Genoese about 1380, and defended by a great stronghold ("bastion"), it was until the French reorganization in 1811 the capital of the island. The city was first attacked by the French in 1553; it was twice captured by the English, in 1745 and in 1794. With its attractive surroundings and fine views, modern Bastia is popular as a tourist resort. The city has tanneries, coral and anchovy fisheries, tobacco and macaroni factories, and exports citrus fruits, chestnut-extract, some copper and ore, fish and other products. Pop. 1931, 44,628.

**BASTILLE, THE**, was the French fortress and prison stormed by the Parisian mob July 14, 1789, the date adopted by the French as their national holiday. The day is revered as symbolical of the first assertion of the popular will against the *ANCIEN RÉGIME*. The building itself was originally a fort begun in 1369 as part of the fortifications of the *Porte St. Antoine*. It was soon enlarged and after 1397 became a state prison. Under Louis XIV the number of political prisoners and the horror of its tiny subterranean cellars reached a maximum. Under Louis XVI it was almost untenanted, averaging about 16 prisoners, but a few persons, particularly radicals, were still held there without trial, and the building still served the people as a symbol of royal power. In the crisis between the King and the National Assembly following the dismissal of Necker the mob threatened to storm the prison, then defended by de Launay with 40 Swiss guards. Upon the promise that the lives of the defenders would be spared, de Launay surrendered, only to be butchered as soon as the mob had entered. Seven prisoners only were found in the fortress. Shortly afterwards the walls were pulled down and the site converted into a public square. Lafayette sent the key of the Bastille to Washington at Mount Vernon where it is still preserved.

**BASTROP**, a city in northern Louisiana and the capital of Morehouse parish. Two railroads serve the city. It is the center of the southwest's greatest gas field. Cotton and fruit growing are the chief agricultural interests. Bastrop has glass and alum products factories, and pulp, paper and saw-mills. Pop. 1920, 1,216; 1930, 5,121.

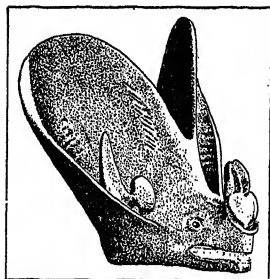
**BASUTOLAND**, a British colony of southeast Africa, lying northeast of the Cape of Good Hope province. Area 11,716 sq. mi. The territory is a reservation set apart for the natives, who are very enlightened and are becoming more numerous. Many of the Basutos are averse from joining the Union of South Africa. European settlement is in general prohibited and the whites here are chiefly traders, officials and missionaries.

The country is mountainous, and the usually perennial rivers have cut deep valleys. There is a good amount of rainfall. Agriculture, consisting of maize and wheat raising, is spreading at the expense of grazing, although there are still many cattle, sheep and goats. The land is held on a communal basis. MASERU, the capital, is reached by a railroad across the Caledon River from Bloomfontein.

Basutoland has been a British territory since 1884. A resident commissioner governs under the high commissioner for South Africa, and is aided by a council of natives nominated by the chiefs. Pop. 1921, 495,937; Europeans, 1,603.

**BAT**, a small furry mammal of the order *Chiroptera*, possessing leathery wings capable of active and long-sustained flight. Of the 450 known species the smallest are no bigger than mice, the largest almost the size of a cat with a wingspread of 5 ft. These wing-handed creatures are cosmopolitan in range. Two main groups are recognized, the small, insectivorous bats of temperate and tropical climates, and the much larger, more numerous and more varied fruit-eating species of the tropics. (See FLYING FOXES.) A few South American bats are known to suck the blood of other mammals, thus earning the name of vampires.

Bats are almost wholly dependent on their wings for locomotion, their ground gait being a shambling crawl. Contrary to popular belief, they have efficient eyes. Some species have grotesque appendages, like crumpled leaves, about the nose or ears, to which important tactile functions are ascribed. They are mostly night fliers, hiding by day in belfries, caves, trees or the rafters of outbuildings where they hang head-downward, wrapped in their wings, suspended by their hind claws. In winter

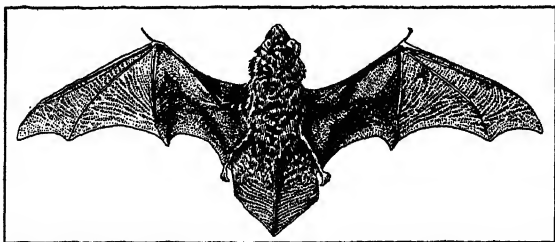


From model in U.S. Natl. Mus.

HEAD OF A BAT (*Megaderma spasma*)

ter vast numbers of these weird-looking creatures hibernate in such retreats, though the few tree-dwelling forms usually migrate to warmer climes.

The species most common in North America are the little brown bat (*Myotis lucifugus*) and the red bat (*Lasiurus borealis*). They render important service



COURTESY AMER. MUS. OF NATL. HISTORY

HOARY BAT

in keeping down insects, which they catch on the wing. In regions like Carlsbad, N.M., where they congregate in unbelievable numbers in dry caves, bat guano supplies a commercially valuable fertilizer.

**BATAILLE, HENRI** (1872-1922), French dramatist, was born at Nîmes, Apr. 4, 1872. He entered the École des Beaux Arts in 1890, but soon thereafter abandoned an art career for playwriting. His first

dramatic effort, *La belle au bois dormant*, written in collaboration with Robert d'Humières and produced at Paris in 1894, failed but a year later Bataille established his literary reputation by a collection of verse, *La chambre blanche*. When his *La lépreuse*, a play set against a Breton background, was produced in 1897 he was recognized as a dramatist of ability. Subsequently produced plays by Bataille include *La marche nuptiale*, 1905, and *Maman Colibri*, 1904. He died at Rueil, near Paris, Mar. 2, 1922.

**BATANGAS**, a port and capital of Batangas province, Philippine Islands, situated on Luzon, about 70 mi. south of Manila. The surrounding territory is rich in sugar, grain, fruit and rice, and Batangas is a heavy exporter of these products. The city is well laid out and has several interesting buildings, chief of which are the convent and former royal palace. Pop. 1918, 41,089.

**BATAVIA**, capital of the Dutch East Indies, situated on the Bay of Batavia on the northeastern coast of Java. One of the most magnificent cities of the East, Batavia is composed of two parts. Trading houses, warehouses and the dwellings of the natives and the Chinese are in the older part near the water front. The new part, a typical Dutch town, contains the modern hotels, public buildings, government institutions and the residences of the wealthy merchants and Europeans. Elaborate tropical gardens enclose the houses. Batavia was founded in 1610 by the Dutch Governor-General Peter Both and was then called Jacatra. Among the important buildings are the palace of the governor-general of the Dutch East Indies and the museum of the Batavian Society of Arts and Sciences. The city has electric railways and lighting as well as telephones and other modern conveniences and utilities.

Besides being the administrative center of the Dutch possessions in the East, Batavia is the most important commercial center in the MALAY ARCHIPELAGO. Immense quantities of coffee, timber, various spices, tea, rice, sugar, rubber, vanilla, drugs, minerals, sago and salt are exported from here. It is also the distributing point for the imports to the Malay Archipelago from Europe, India, China and Japan. Population of the city of Batavia is about 260,000; of the residency about 1,000,000.

**BATAVIA**, a city in Kane Co., northeastern Illinois, 36 mi. west of Chicago. Three railroads afford transportation. Batavia is located in a farming and dairying region. It has wagon, farm implements and radio tower factories, foundries and galvanizing works. The city was founded in 1833 and chartered in 1891. Pop. 1920, 4,395; 1930, 5,045.

**BATAVIA**, a city in northwestern New York, the county seat of Genesee Co., situated on Tonawanda Creek, about 35 mi. northeast of Buffalo. Batavia is a trade and railroad center, served by several lines, in a fertile fruit-growing and agricultural district. The city's factories produce farm machinery, shoes, die-castings and various other commodities. The manufacturing output, 1929, amounted to \$13,050,715.



The retail business in 1929 amounted to \$11,916,161. Batavia is the seat of the State School for the Blind.

Joseph Ellicott founded Batavia in 1798, making it the capital of the Holland Purchase. The Holland Office Building is now a museum. The city was incorporated in 1915. Batavia was a military camp and center for refugees during the War of 1812. It was the home of William Morgan, believed to have been murdered in 1826 by the Masons because he threatened to disclose the secrets of that society. The Tonawanda Indian Reservation is nearby. Pop. 1920, 13,541; 1930, 17,375.

**BATAVIAN REPUBLIC.** During the winter of 1794-95 the French armies drove the allied English, Dutch and Hanoverian armies out of Holland, and the Stadtholder fled to England. The French Government had no desire to annex the country, and therefore combined with Dutch liberals to organize the Batavian Republic, modeled after the French Republic. It comprised Holland alone, Belgium having been annexed by France previously. An alliance between the two republics was signed in 1795. The Dutch fleet was destroyed by the English at Camperdown in 1797. The Batavian Constitution followed closely the vicissitudes of government in France, the government becoming in turn a republic, a Directory, and a Consulate. Under French domination the Dutch were consolidated into a unified nation, and enjoyed great material prosperity until the establishment of the Continental System. In 1806 the Batavian Republic was supplanted by the Kingdom of Holland, with Napoleon's brother Louis as monarch. See NETHERLANDS, HISTORY OF.

**BATES, HENRY WALTER** (1825-92), British naturalist. While working as a clerk, he met A. R. WALLACE a collector of botanical specimens, and went with him to the Amazon. At first they collected together, but later separately, Bates exploring the Amazon and Wallace the Rio Negro. In 1859 Bates returned to England with several hundred new species of insects, including many butterflies. At the suggestion of C. R. DARWIN he wrote *The Naturalist on the River Amazonas*, which is one of the best books on the Amazon ever written. Bates was born at Leicester, England, Feb. 8, 1825, and died at London, Feb. 16, 1892.

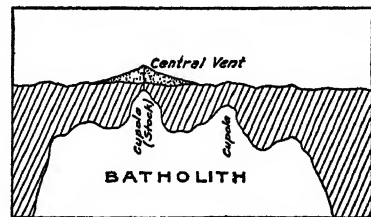
**BATES COLLEGE**, a coeducational institution at Lewiston, Me., was founded by the Free Baptists and was an outgrowth of Maine State Seminary. It was chartered under its present name in 1864. The college is privately controlled, with no denominational restrictions. In 1931 its productive funds amounted to \$1,862,657. Coram Library of 60,635 volumes contains the Rice Collection of French history and biography. In 1931-32 the student enrollment was 712, and the faculty of 46 was headed by Pres. Clifton Daggett Gray.

**BATH**, a city and spa of Somersetshire, England, situated on the Avon River, 12 mi. southeast of Bristol. Known as *Aquae Solis* in Roman times, Bath is a fashionable spa. It is enclosed by an amphitheater

of hills and, built chiefly of white stone, presents an unusually handsome appearance. The principal buildings are the imposing Abbey Church of the late Gothic style, the guild-hall, the theater, the buildings used in connection with the baths, and the churches of St. Michael and St. James. Royal Victoria Park is in the western section of the city. Having been a gathering place for the aristocracy of England for many years, Bath has had a remarkably colorful history, and is today visited by hundreds of tourists annually. Pop. 1921, 68,669; 1931, 68,801.

**BATH**, a port city near the coast of Maine, the county seat of Sagadahoc Co., situated on the Kennebec River, 30 mi. northeast of Portland. Steamships and the Maine Central Railroad serve the city. A bridge across the Kennebec connects Bath with Woolwich. The region produces poultry, dairy products, truck and fruit. Pine and spruce timber are found in the district. Bath had a very important shipbuilding industry, at its height during the World War, when this trade increased the population 50% in a short time. Shipbuilding in the city declined greatly from 1918 till 1928. Yachts, trawlers and Coast Guard boats are now built extensively. Other industries include box and clothing manufacture and foundry work. Bath, with its fine harbor, has a large domestic shipping trade. There are many attractive summer resorts in the vicinity. The site of Bath dates back to a deed of 1660; the city was incorporated in 1847. Pop. 1920, 14,731; 1930, 9,110.

**BATHOLITH**, a huge mass of molten igneous rock penetrating up into overlying sedimentary or IGNEOUS ROCKS. The mass solidifies at considerable depth and is exposed at the surface only when erosion



FROM R. A. DALY, IGNEOUS ROCKS AND THEIR ORIGIN, MCGRAW-HILL BOOK CO.

FORMATION OF VOLCANIC VENT FROM A RISING MAGMA (IDEAL SECTION)

has removed the overlying material. It is usually steep-sided, with no determinable floor, and its horizontal dimensions may be measured in hundreds of miles. In structure the rock is coarsely crystalline. See also ABYSSAL ROCKS; LACCOLITH; BOSS; PETROLOGY.

**BATH PREPARATIONS.** The modern bath offers opportunity for the use of many luxurious cosmetics. Perfumed soaps, bath salts for perfuming and softening the bath water (for which therapeutic claims are sometimes made), bath powders and bath lotions used after the bath, all contribute toward making the bath a pleasant process. It is an interesting fact, that with the tremendous increase in the use of cosmetics in recent years, the employment of many luxurious

preparations is no longer limited to people of wealth, as inexpensive forms of these toilet luxuries are now manufactured.

*Bath soaps*, basically the same as ordinary toilet soap, hard milled, and made into larger tablets than the soap intended for face and hands. (See also SOAP; FACE SOAP.)

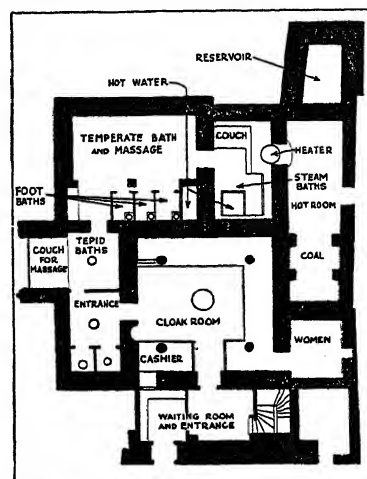
*Bath salts*, or *bath crystals*, are used for perfuming the bath and softening the water. The two ingredients often used for them are sodium carbonate and borax, or sodium sulphate and bay salt. They are first dyed a delicate color and then perfumed. As in the case of most cosmetics, perfuming offers a real problem to the manufacturer, as on the quality of the perfume depends the quality of the crystals. Bath tablets are made of bath salts by heavy compression. (See also PERFUMES; TOILET WATER.)

*Bath powder*, the modern commercial form of talcum powder (see TALC) which was introduced in the latter part of the 19th century. It is made of finely powdered magnesium silicate and perfumed. Until about 1920 talcum powder was put up entirely in tins with perforated tops, and sold for very moderate prices. Since then it is packaged and perfumed more expensively and often sold for several dollars a box. Bath powder is used for dusting the body after the bath, and is often called Dusting Powder. G. R. F.

**BATHS**, architecturally, buildings or groups of buildings devoted to bathing. Bathrooms evidently developed in comparatively early civilizations. They are found in Egypt, and in the Aegean civilization were made important features with elaborate arrangements for water supply and drainage, as in the Palace at Cnossus of about 1500 B.C. and in the Helladic Palace at Tiryns on the mainland of about 1200 B.C. Greek vase paintings of the 5th century show that bathing was common, and that bathrooms with water pouring down as in a modern shower bath existed. Yet there is no architectural evidence of complex or monumental bathing establishments except in connection with the Gymnasia. The gymnasium at Delphi has a plunge and a shower bathroom as important elements. It was in Hellenistic times in Asia and Egypt that the possible luxury of bathing establishments was first developed, and the Roman establishments may have been inspired by them.

The earliest Roman baths yet known are the Stabaian Baths at Pompeii of the 2nd century B.C., largely altered about 80 B.C., and redecorated later still. The so-called Baths of the Forum of about 80 B.C. are smaller. At the time of the destruction of the city, a more magnificent establishment was under construction. All three are basically similar in type, and quite different from the *thermae* of Rome. They consist of a series of halls on one side of a court, usually three in number: an *apodypterium*, or dressing room, where the bathers' clothes were kept, usually in recessed cabinets around the walls; a *tepidarium* or warm room; a *calidarium*, or hot room; and in the Baths of the Forum and the Stabaian Baths, a small circular *frigidarium* or cold bath covered with

a conical roof. In the Stabaian Baths and the uncompleted baths there was also a swimming pool in the court, and the latter had a circular room, heated, for a *laconicum* or steam room. The basic system in the baths of Timgad and Leptis Magna in Africa, and at



FROM HENRI SALADIN. L'ART MUSULMAN

BATHS OF THE PALACE OF BARDO NEAR  
TUNIS

Design by H. Saladin, after Dupertuys

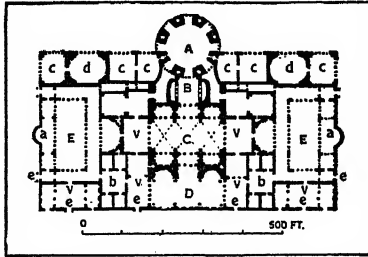
Trier in the Rhine country is similar. It probably was the standard arrangement for the Roman provincial cities, and can be traced in many cities of Spain and Germany as in Italica, and Alanje, Spain. In the Stabaian and Forum Baths in Pompeii there is a smaller and plainer set of bathrooms for women.

Such an establishment as even the simplest Roman bath required arrangements for heating some of the rooms as well as the water. Usually three separate metallic reservoirs were arranged in connection with a furnace, so that water flowed from the one furthest from the fire into one slightly nearer, and from that into the last directly over the flames. The first was fed from the city supply, and from it water was piped to the cold baths and basins. From the second water was piped to the tepidarium, and from the last to the calidarium, thus providing gradations of temperature, and circulation which prevented overheating. The rooms were heated by means of a hypocaust, that is a system of hollow floors and walls through which the smoke and heated air from a fire circulated. The usual method of construction was to build a series of piers about two feet high, closely spaced, on which was placed a concrete floor, sometimes supported on tiles that bridged from post to post, and sometimes self-supporting. The hollow space under the floor thus made was connected with a furnace at one side, and with openings into hollow wall flues that carried up around the room to an outlet above the roofs. This system is said to have been invented by Sergius Orata at the beginning of the 1st century B.C.

**The Great Thermae of Rome.** It was only in Rome itself that the baths received their most complete architectural expression, in a remarkable series



of imperial baths, of which those of Titus, Trajan, Caracalla and Diocletian were the largest and most magnificent. The scheme of these imperial *thermae* comprised a central block of great bathing chambers surrounded on three sides, or all around, by a wide open garden space for games and sports. The whole was enclosed with ranges of minor rooms, some for recreation, such as libraries; some for service. At times, as in the Baths of Caracalla, there were shops



A. D. F. HAMLIN. A HISTORY OF ARCHITECTURE, LONGMANS, GREEN & CO.

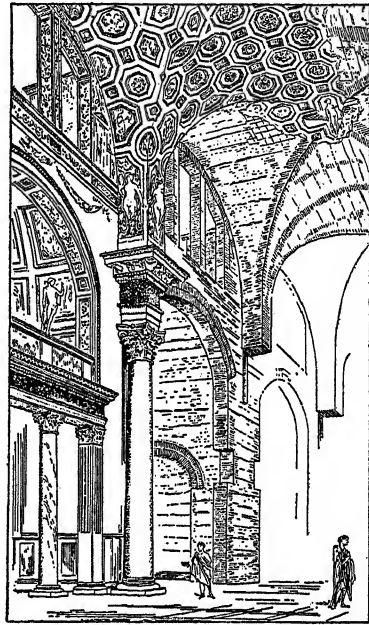
#### BATHS OF CARACALLA, ROME

*Plan of central block, showing: A, calidarium, or hot bath; B, intermediate chamber; C, tepidarium, or warm bath; D, frigidarium, or cold bath; E, peristyles; a, gymnastic rooms; b, dressing rooms; c, cooling rooms; d, small courts; e, entrances; v, vestibules*

fronting the streets. The central block and its surrounding gardens were placed on an artificial terrace, beneath which ran ample service corridors allowing rapid communication to all parts of the group. The central block was the core and climax of the whole, and it was always planned around a great central hall, usually termed the tepidarium. The absence of hypocausts from this central hall suggests that it played rather the part of a lounge or lobby. From this central hall there opened out recesses, usually with bathing tanks in them, and the other important rooms. Among these were the frigidarium that took the form of a plunge or swimming bath of enormous size, probably without a roof, and a calidarium, sometimes as in the case of the Baths of Caracalla, in the form of a domed chamber of enormous size. In all the imperial baths this central block was planned with consummate skill, and the problem of adequate lighting of the central hall was solved through the use of large clerestory windows. This meant that the vaults had to be of the intersecting groined type. The concentrated weights and thrusts resulting at the points of support made necessary great piers and buttresses, which were cleverly planned to enclose necessary recesses, or to act as the necessary divisions between rooms. Structure, use and decorative effect were thus integrated into one great whole.

The decoration was as rich as the planning and structure were brilliant. Exteriors were generally plain, with stuccoed walls. In the Baths of Caracalla mosaic was used to embellish at least the upper portions. Columns of marble and polished granite were used lavishly to form screens before recesses, or at the entrances of rooms, in colonnades around the courts,

and also on the fronts of the great piers supporting the high vaults. Floors were of marble, resembling the floor of the existing Pantheon in Rome, or of rich marble mosaic. The lower walls were sheathed in



FROM E. VIOULET-LE-DUC, DICTIONNAIRE

#### ROMAN BATH

*Reconstruction of a section of the Baths of Caracalla*

marble, and the upper walls and vaults decorated with painting, stucco relief and, at least in some cases, with glass mosaics. The clerestory windows were probably set in frames and grilles of bronze. The great hall of the *Thermae* of Diocletian, about 303, transformed into the church of Santa Maria degli Angeli by Michelangelo in the 16th century, still retains most of its original forms and much of the original decoration.

These great structures were gifts to the people by the emperors; admission to them was either free, or merely nominal in amount. The same establishments were used by both men and women, sometimes at different hours, sometimes together. The abuses of such wholesale and luxurious promiscuous bathing led periodically to efforts at reform through stipulating different hours for the two sexes; and periodical waves of liberalism relaxed the regulations. Excellent contemporary pictures of life in the Roman baths can be found in many Latin writers, particularly Juvenal, Martial, Seneca, Pliny the Younger, and Ausonius, in the 4th century.

**Medieval Europe.** The luxury of the Roman *Thermae* and the abuse of the custom of promiscuous bathing inevitably led to tremendous protests against it by the early Church Fathers. The final abandonment of the *Thermae*, however, came less from moral obloquy than from the fact that one by one the Roman aqueducts were broken, and the abundant water they supplied was cut off. Throughout the

dark ages and well into brighter medieval times, bathing establishments were scarce, and bathing itself was looked upon as a sin except for purpose of cleanliness, and even sometimes then. Nevertheless, the growing town life of the 12th century had developed town bath houses, usually consisting of a simple row of large tubs in a single room. In these, as in the Roman baths, bathing was sometimes promiscuous. That the same abuses continued can be seen in the persistence of *bagnio*, Italian for bath, as a colloquial term for a brothel. This medieval type continued in use until late in the Renaissance, and is frequently pictured in engravings. In the later Gothic period, there was much private bathing in the pools or fountains of castle gardens.

**Renaissance and 18th Century.** In many sanitary ways, the castle or chateau of the time of Louis XIV was far behind the corresponding 13th century building. Even in royal palaces the arrangements for bathing were of the simplest, consisting of movable tubs that had to be filled and emptied by hand. By the time of Louis XVI in France, however, separate rooms of considerable elaborateness were set off as bathrooms, though plumbing was still largely absent. Public baths were equally primitive; certain bathing establishments were beginning to develop along the banks of rivers or lakes. Casanova's spicy account of such an establishment near Berne in Switzerland shows how even at that time bathing and prostitution were closely related.

**Mohammedan Baths.** In the eastern empire, baths seem to have continued luxurious and popular. The ruins of several baths of the 5th, 6th and 7th centuries have been found in Syria. The Mohammedan conquerors borrowed the custom, erected personal cleanliness into a cardinal virtue, and developed luxurious bathing establishments wherever they resided. The bathrooms of the 14th century Alhambra at Granada are typical of the Moorish type. It was in Persia and Turkey that the finest and most architecturally important baths were developed. In Turkey these took the form of a series of square halls, covered with domes, and lighted by glass lights in the dome. The basins were either in the center, or in the hot rooms, on one side. There was also a dressing room, and frequently a luxurious lounge as well. Constantinople has over a hundred such buildings, large and small, and their ranked domes give a great deal of the character to any view over the city. In Persia, though domed halls are used, rectangular rooms covered with groined or barrel vaults also occur.

**Contemporary Baths.** With the growth of the social conscience and the increasing sense of the importance of cleanliness that characterized the last half of the 19th century, it was inevitable that municipal and other types of public bathing establishments should be built, particularly in continental Europe. In America, where individual plumbing was more rapidly installed, and in England where the custom of the movable tub long continued in use, there was less need for these, though there are few large cities

in either England or America without municipal or public bath facilities of various sorts. At first these establishments consisted merely of a series of individual bathrooms equipped with tubs. Later showers came into use, and then swimming baths.

The modern European public bath is often a large and complex building, comprising frequently two complete baths, first and second class. A division of the sexes was common at first, but the usual practice in the newer baths is to require bathing suits to be worn and to have mixed bathing. The pool is always so arranged that it can be reached only through the showers. Frequently cafes are included in the building. Many commercial swimming pools, both outdoors and in, give evidence of the popularity of swimming in Europe and America. Hotels, athletic clubs, amusement parks and steamships have them commonly. In Paris there is one connected with a restaurant which is run with all the luxury of a night club. The modern swimming bath is usually of reinforced concrete, lined with tile, and surrounded with a gutter which removes floating impurities. The entire room may be tile or marble wainscoted. If possible it is brilliantly day lighted, often by sky lights. Occasionally night lighting will be partially by waterproof reflectors below the pool surface. Roman or Pompeian precedent often furnishes the inspiration of the design.

Modern private bathrooms have received great attention on the part of designers as well as engineers. Tile and marble wainscots are common; floors are of tile, linoleum or rubber composition. Richness of color is gradually replacing the earlier hospital-like white, even for the plumbing fixtures themselves. Showers, often glass enclosed, either over the tub or as separate units, are more and more common, and in the United States the European custom of including a bidet as part of the equipment is growing. In the larger houses, the bathroom is becoming more and more a sort of boudoir, with a dressing table and chairs, and with the fixtures themselves withdrawn into alcoves, recesses or separate compartments opening from it. In Russia, perhaps through Mohammedan or Greek influence, steam baths have received a high development. Architecturally, however, Russian baths are simple, consisting of one room for the hot bath, usually filled with steam by throwing water upon a tiled masonry stove, and one room for a cold bath or plunge. Frequently this last room is omitted, and a lake, pond or river used as a plunge. Bathing is highly esteemed by the Chinese and Japanese, especially the latter. Japanese baths in private houses and the native hotels consist of a large circular wooden tub usually standing in a retired court. This is filled with extremely hot water, and one filling is used for all the members of a family. There are also occasional large public baths, especially at places with hot or medicinal springs, as in the famous group at Matsuyama on the island of Shikoku. In neither these nor the private baths is there any consideration of privacy.

**The Cure Bath Establishments.** Baths have grown up around hot medicinal springs for many ages. In England, the elaborate remains of the Roman baths at Bath show that the beneficial character of that source was well appreciated even then. In the 18th century English architects began to beautify their own sources, such as Bath or Harrogate, with adequate buildings. It was in the second half of the 19th century, however, and in the famous continental *cures*, that complete establishments were most lavishly developed, so that the patient taking the cure might be surrounded with every luxury and have every recreation at his command. The complete great cure establishments, therefore, besides the baths proper, usually arranged with a series of individual bath-rooms, had as well a casino for gambling, restaurants and cafés, gardens and a theatre and concert hall. Similar elaborate groups have grown up at various continental sea-baths, with dressing tents or cabins taking the place of the bathrooms of the cure, as at Ostend, Dieppe, La Boule, Trouville, Deauville and the Lido.

For the medical aspects of baths, see ELECTROTHERAPY, HYDROTHERAPY.

T. F. H.

**BATHURST**, a town in Gloucester Co., New Brunswick, Canada, situated on a small peninsula projecting into Bathurst Harbor, 211 mi. northeast of St. John. Of four rivers flowing into the harbor, the Nepisquit is particularly famed for salmon. Deep sea fishing, paper, pulp and timber industries are important. Bathurst, because of its location and picturesque environs, is popular as a summer resort. Pop. 1921, 3,327; 1931, 3,300.

**BATIK**, an ancient process of resist dyeing, originated in the Orient. In the modern revival of ARTS AND CRAFTS it has become a popular form of art expression. It came into Europe from the Dutch East Indies under the Javanese name *batik*, meaning "wax painting." The art was and is practiced also in India and China.

The batik process is as follows. After the pattern is outlined on the prepared cloth, hot melted wax is applied to those parts of the pattern which are to remain undyed. This wax is solidified in cold water, and the cloth is then dipped in a cool or lukewarm dye. When the wax is boiled out in soapsuds, the protected parts appear the natural color of the cloth, white or cream-colored. If more than one color is required, the whole process is repeated. The Javanese wash out the wax each time. Europeans and Americans, using their knowledge of color combinations, very often dye one color over another to produce the desired shade.

The Javanese designs, centuries old, are applied largely to clothing and are mostly of the all-over sort, varied by elaborate borders. They are characterized by almost incredible intricacy, delicacy and accuracy of execution. The ingenious Javanese tool, the *tjanting*, a small copper cup with a bamboo handle, is furnished with one or more capillary tubes through which the melted wax flows in an easily controlled

stream. Large spaces are waxed by a cotton wad on the end of a stick, or by a brush. If the wax cracks in the dyeing, a crackled effect is produced, which is sometimes attractive. A marvelous example of cotton batik from the island of Bali, east of Java, may be seen in the Museum of Fine Arts, Boston. In this case a design of gold leaf enriches the colored pattern.

Remarkable batik work is done in India with different tools. The best specimens of the wire-brush work are the palampores of Masulipatam, some of which are made for wall hangings, of Mohammedan prayer rug designs, and others for canopies in Hindu temples, for which mythological designs are employed. At Peshawar, after the resist is used for the last time with the iron style, gold or silver powder is scattered on, making a glittering, metallic pattern. In the bandana fabrics of Gujarat and Rajputana the resist is of a different nature. The cloth is tied up tight with thread before dyeing, in a way which produces a more or less elaborate pattern of spots, squares or zigzags, as the knots form a resist to the dye. Hence the name "bandana handkerchief" from the Hindu word meaning "tie."

The handwork required by batik makes it too expensive for ordinary clothing to-day. But its unique beauty has attracted artists of genius, who apply it to more permanent articles of furnishing, such as wall and window hangings, couch and bedcovers, table scarfs and the like. Their designs, like the medieval tapestries, include elaborate scenes from history, mythology and architecture, and the effects are brilliant and beautiful.

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**BATLEY**, a municipal borough of West Riding in Yorkshire, England, at the junction of the East Pennines and the Yorkshire plain, 8 mi. southwest of Leeds. The town is largely modern in construction although there is the Perpendicular Church of All Saints boasting excellent 17th century woodwork. Lying in the southwestern Yorkshire coalfields, Batley has iron foundries and machine manufactures, but its primary industries are in woollens; the manufacture of pilot cloths, druggets, and flushings, and the working up of old material into shoddy. Since 1918 modern processes, especially in utilizing artificial silks, have become emphasized. Pop. 1921, 36,137; 1931, 34,573.

**BATLLE Y ORDOÑEZ, JOSÉ** (1856-1929), Uruguayan President, was born May 21, 1856 in Montevideo and educated in Uruguay and Europe. In 1881 Batlle began his public life, first as the editor of liberal newspapers and then in various offices, reaching the presidency of the Senate in 1899. He was elected President of Uruguay for the term 1903-07 and again from 1911-15. In the first term he devoted much time to public works, and in the second he put forth his program for a constitutional change in 1912, proposing the revision of the constitution of 1829. He advocated the creation of a collegiate executive, liberty of worship and other liberal reforms, and his

ideas were embodied in the constitution of 1919, a unique experiment in political science. Batlle believed a "collegiate executive" would lessen the attractiveness and temptations of the Presidential office. Batlle represents an era and philosophy known in Uruguay as *Batllismo*, one of the features of which is the government ownership and operation of public utilities and key industries. In 1920 he was elected to the national council of administration. Batlle died in 1929.

**BATON ROUGE**, the capital of Louisiana and of East Baton Rouge Parish, situated in the southeastern part of the state, 90 mi. northwest of New Orleans. Baton Rouge, which still has many characteristics of a Spanish city, stands on the bluffs of the Mississippi River well above the high water mark reached by floods. Its port has harbor accommodations for ocean going vessels, and the city is on five railroad lines. There is a municipal airport. Baton Rouge is a shipping point for sugar, cotton and rice and an important industrial center with rice and sugar mills, chemical plants and veneer factories. In 1929 the manufactures reached approximately \$4,000,000; the retail trade amounted to \$19,069,708. There are extensive refineries bringing in petroleum by rail, water and pipe lines. Baton Rouge is the seat of the University of Louisiana and Agricultural and Mechanical College, of which Audubon Sugar School, established to train sugar plantation managers, is a unique feature.

The old Spanish buildings and the beautiful plantation houses built before the Civil War give great charm to the city and its vicinity. Baton Rouge was settled by the French. In 1763, when West Florida came into possession of the British, Baton Rouge was included; however, in 1779, Bernardo de Galvez, Spanish governor of Louisiana, captured the town. During the Civil War it was the scene of much fighting. In 1862 Federal troops took Baton Rouge and held it, except for one month, until the close of the war. For several years Zachary Taylor, while brigadier-general in the United States Army, lived in the city. Pop. 1920, 21,782; 1930, 30,729.

**BATRACHIA**, Batrachians. See AMPHIBIANS.

**BATTALION**, a military unit composed basically of a HEADQUARTERS and two or more COMPANIES, BATTERIES or similar organizations, and commanded by a MAJOR. The INFANTRY battalion war strength consists of a headquarters, headquarters company, three rifle companies and one machine gun company. It has 28 officers, 824 enlisted men and 54 horses. Its fire-power is 546 rifles, 54 automatic rifles, 12 machine guns and pistols and grenades. A battalion of 75 mm. gun, horse-drawn field artillery, war strength, has a headquarters, headquarters battery, combat train, three batteries of four guns each and nine machine guns for antiaircraft work. It has 23 officers, 607 men and 648 horses. A battalion of 155 mm. howitzer, motorized field artillery, classed as medium artillery, has two batteries of four howitzers each and four machine guns. The battalion is the smallest

artillery tactical unit and the battalion commander directs the fire of the batteries while the battery commanders control their fire. The battalion is also the smallest artillery unit with a STAFF.

During the 16th century the battalion was a tactical formation grouped on the battlefield in square, circular or triangular shape, several thousand men strong and composed of all arms. In 1635, France divided her infantry regiments, which were not standardized in strength, into battalions of uniform size, subdivided into PLATOONS. This system was gradually adopted by other countries. For 200 years the strength of infantry battalions has been from about 600 to 1,000 men. During the 18th century, battalions of infantry reached a high point of perfection in drill and maneuver, culminating in the superbly trained battalions of Frederick the Great. At this time the infantry battalion became a tactical unit, and continued as such until 1867. J. W. W.

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**BATTERIES, RADIO.** Batteries serve three main purposes in radio. First, they supply current for heating the filaments of tubes (see TUBES, ELECTRONIC). Such service requires considerable current-hour capacity, and STORAGE CELLS are commonly used, except when the tubes are especially constructed to require low heating currents. In the latter case, dry cells of large size may be used (see CELLS, voltaic or PRIMARY). Filament-heating batteries are designated as "A" batteries.

The second service is to supply relatively high potentials, but small currents, to the filament-plate circuits of tubes. These batteries are called "B" batteries. They may be blocks of small, series-connected dry cells or similarly connected storage batteries.

"C" batteries are used to apply potentials between the filaments and control grids of tubes. They supply negligible current and are constructed much like "B" batteries, but they have smaller dimensions.

L. G. H.

**BATTERIES OF WARSHIPS.** The guns of the largest calibers carried for use against similar ships, comprise the main batteries (12 to 16 ins.) on BATTLESHIPS. For use against lighter craft, particularly destroyers, other smaller guns of about 5 in. caliber comprise the secondary batteries, and guns designed for use against aircraft comprise the antiaircraft batteries. In some cases, however, double-purpose guns suitable for work both against light surface-craft and against aircraft are used, so combining the functions of the secondary and antiaircraft batteries. The 8 in. treaty cruisers have smaller guns of 3 to 5 in. caliber (5 in. in the U.S. Navy), but 6 in. cruisers generally mount no smaller guns. Auxiliaries carry 4 to 6 in. guns; destroyers, 4 to 5 in. guns; and submarines, 3 to 6 in. guns. See also ARTILLERY, Naval. G. L. S.

**BATTERY, MILITARY.** See ARTILLERY, Army.

**BATTERY, THE**, the southern part of Manhattan Island, New York City. It is an area of 21 acres, originally fortified by a row of cannon extend-

ing from the foot of Greenwich street to the meeting of Walker and Whitehall streets. Battery Park is now flanked on the north by the skyscrapers of the financial districts. The Aquarium was built about 1807-11 as a fortress, and later as Castle Garden was used as a place of amusement. Jenny Lind sang here in 1850.

**BATTLE**, an engagement involving combat between two opposing forces, military or naval. Loosely applied it includes any such engagement, regardless of its importance or duration or the size of the forces involved.

**Land Battle.** In land warfare, the term applied strictly means a general engagement between large bodies of troops, where the result bears an important influence upon the outcome of the campaign or war; for example, the Battle of Gettysburg or the Battle of Waterloo. In contradistinction lesser engagements are referred to as encounters or skirmishes. There is difficulty in separating the fighting along the Western Front during the WORLD WAR into battles and CAMPAIGNS due to the fact that opposing forces were more or less continuously engaged throughout the war. The difficulty is evaded by referring to separate phases as drives or offensives. Sharp conflict between large forces as that at Cambrai or at St. Mihiel answers sufficiently the definition of a battle. E. D. P.

**Battle at Sea.** In a modern war among any of the great nations, mastery of the sea is the objective sought, and therefore, in any engagement, small or large, the supreme effort must be made in the use of the men and material involved to win victory. The great thing to be considered is to so handle the forces assembled that the maximum power may not only be exerted throughout a campaign, but especially exerted in the battles at sea that are the campaign's crucial and decisive points.

In the World War there were three main engagements on which to base theories. 1. The action off Coronel, where the British ships were destroyed and sunk by the Germans with no survivors; 2. the action at the Falkland Islands, where two British cruisers destroyed the German vessels, some of which had previously been in the action off Coronel; 3. the Battle of Jutland, fought in low visibility.

Naval weapons are carried on ships of various types, the types being more or less standard in all navies. As a general rule, each type has been developed to utilize one of the weapons as its primary weapon, and though it may carry other weapons, they are of secondary importance; the ships of a type being operated in a battle in a way to make a primary weapon most effective. Thus, while CAPITAL SHIPS may carry both guns and torpedoes, the gun is their primary weapon, and capital ships are operated in battle to make their guns more effective.

While destroyers carry both torpedoes and light guns, the torpedo is their primary weapon, and the guns of destroyers in battle are for the end of getting their torpedoes home across enemy countries' ships. Light cruisers which carry intermediate guns and

torpedoes have a double rôle, the torpedoes being the primary weapon against the capital ships, and the guns, the primary weapon against light ships.

Fleet mine layers may carry both MINES and torpedoes, but the mine is primary until expended, at which time that type may change its range or tactics so as to make its guns or torpedoes effective. Anti-submarine craft carry both depth Bombs and torpedoes; the depth bombs being primary when operating against submarines, the torpedo, when operating against heavy ships.

SUBMARINES carry only torpedoes, and their function is to produce a maximum effect on the enemy. Bombs and aerial torpedoes are launched from aircraft, which must be carried to the scene of engagement in carriers.

In addition to having the equipment necessary to make its primary weapon effective, each type of ship has been given such other characteristics as will best enable it to make use of that weapon. These characteristics are expressed in speed, maneuvering ability and submergence. So in modern battle fleets there are battleships, of great size, medium speed, heavy armor, many heavy guns and several airplanes; battle cruisers, of size equal to battleships, high speed, little armor, heavy guns and several airplanes; destroyers, of small size, high speed, many torpedoes, no armor and small guns; light cruisers, of medium size, high speed, light armor, intermediate guns, some torpedoes and two observation planes; light mine layers, similar to destroyers but carrying mines at the expense of torpedoes; anti-submarine craft, similar to destroyers but carrying depth charges possibly at the expense of some torpedoes; submarines, of medium surface speed carrying only torpedoes; and aircraft carriers, with characteristics similar to battle cruisers but carrying intermediate guns and airplanes instead of heavy guns.

When two fleets are to meet in the open sea, practically equal in force, tactics come into play. The question of the approach, the question of deployment and the point of contact, main, or secondary, are to be considered; and to obtain success, the important points of contact must be along the line of making the main point of contact the main objective in battle. See also NAVAL AVIATION.

R. E. C.

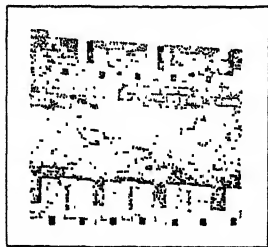
**BATTLE**, a small market town of Sussex, England, about 6 mi. northwest of Hastings, and situated on a mound once described as the thyme-clad hill of Senlac. The place-name is derived from the Battle of Hastings, 1066, or, the Battle of Senlac as the victors termed it, which, by the defeat of King Harold, gave William the Conqueror the English crown. The chief modern interest in Battle lies in its abbey originally erected by the Conqueror in fulfillment of a vow. Begun in 1067 it was consecrated in 1094. Very little of the Norman church survives, but Battle Abbey boasts one of the most beautiful medieval Decorated gateways in England, the remains of a fine Early English refectory, and cloisters of Perpendicular style. Originally the abbey served as a Benedictine monastery, but to-day the buildings, largely restored and



modernized, house a girls' school. The interests of Battle lie in a fortnightly cattle market and in tourist traffic. Pop. 1921, 2,891; 1931, 3,490.

**BATTLE CREEK**, a city of Calhoun Co., southern Michigan, situated at the confluence of Battle Creek and the Kalamazoo River, about 120 mi. west of Detroit. It is served by the Michigan Central and the Grand Trunk railways and bus and truck lines. There is an airport. Battle Creek is located in the midst of a fertile fruit-growing and agricultural region, of which it is a trading center. It is the home of the famous Battle Creek Sanatorium, noted for its dietetic experiments, which led to the extensive manufacture of health foods and widely-known cooked cereals. Other local manufactures include farm implements and surgical appliances. In 1929 the factory output was worth about \$87,000,000; the retail trade amounted to \$33,257,542. Founded in 1831, Battle Creek was named, according to tradition, because of a skirmish that took place between the surveyors and the Indians. The settlement was incorporated as a village in 1850 and was chartered as a city 9 years later. Pop. 1920, 36,164; 1930, 43,573.

**BATTLEMENT**, a parapet consisting of alternating high portions, known as merlons, and lower portions called crenels; the whole is termed a crenelated parapet. Battlements were developed in order that



MEDIEVAL BATTLEMENTS, FROM THE CITY WALLS OF CARCASSONNE, FRANCE

archers, protected by the higher portions, might be able to shoot over the lower portions, or sometimes in later work, directly through loop holes in the center of the merlons. The battlement is found in ancient military architecture, in Mesopotamia, Egypt, Greece and Rome, as well as in the Chinese city walls, but was most highly de-

veloped in feudal Europe. It was retained in much later Gothic architecture as a decorative feature, and is frequently ornamented with pierced tracery.

See Viollet-le-Duc, *Dictionnaire raisonné*, article Creneau.

**BATTLESHIP**. See DREADNAUGHT; WARSHIPS.

**BATUM**, capital of the Adzharistan Autonomous Soviet Socialist Republic, affiliated to the Georgian S.S.R., and port on the southeastern coast of the Black Sea. Snow-clad Caucasian peaks in the background modify Batum's marshy situation and humid, fever-bearing climate. Orange groves, tea plantations, eucalyptus, mimosa trees and other tropical plants adorn the city. There is a special oil harbor, the export point for oil and oil products coming from BAKU via pipe lines or rail. Immense quantities of manganese are exported, as well as raw silk, hardwoods, wool and grain. Known as Bathys in ancient times, Batum later submitted to Turkish conquest and became Russian territory in 1878. Pop. 1929, 48,474.

**BAUCIS and PHILEMON**, in mythology, a devoted couple who entertained JUPITER and MERCURY,

disguised as travelers, when everyone else in the village turned them away. As a reward the gods destroyed the town by flood, but floated their house and transformed it into a temple. The couple were allowed to serve Jupiter in the temple and to die together. They were then changed into trees.

**BAUDELAIRE, PIERRE CHARLES** (1821-67), French poet, was born in Paris, Apr. 9, 1821, and educated at the Collège Louis-le-Grand in Paris. He traveled in the Orient from 1841-43, and was particularly influenced by his experiences in India. His travels finished, he did considerable art and literary criticism in Paris, revealing immediately his remarkable gifts as a prose writer. He was a conspicuous member of the Romantic school and was especially intimate with THÉOPHILE GAUTIER. In 1846 Baudelaire began his superb translation of the prose and poetry of EDGAR ALLAN POE; the influence of this translation was long felt in French literature. In 1857 he published his celebrated *Fleurs du mal*, or *Flowers of Evil*, a volume of poems in exquisite style, embodying the poet's "decadent" and "satanic" ideas and visions. This was followed by *Petits Poèmes en Prose*. Baudelaire's fame, both as poet and critic, has grown until he is now generally ranked as one of the most important French writers of the 19th century. He died in Brussels, Belgium, Aug. 31, 1867.

**BAUER, HAROLD** (1873- ), English pianist, was born at London, April 28, 1873. He studied the violin with Adolph Pollitzer and made his début with that instrument in 1883. On the recommendation of IGNAZ PADEREWSKI he devoted himself to the piano, which he studied in Paris, making his début there in 1893. In the next seven years he performed in the chief cities of Europe, where his technical brilliance and polish of phrase earned him a place among the foremost modern pianists. In 1900 he made his début in the United States with the Boston Symphony Orchestra, thereafter appearing frequently in this country as an ensemble player and in recital.

**BAUMGARTEN, ALEXANDER GOTTLIEB** (1714-62), German philosopher, was born at Berlin, July 17, 1714. He was a follower of C. von Wolf and G. W. LEIBNITZ, and in 1740 was appointed professor of philosophy at Frankfurt-on-the-Oder. Baumgarten founded the school of esthetics. His *Metaphysics*, published in 1739, is still considered useful as an exposition of the Wolfian philosophy. He died at Frankfurt-on-the-Oder, May 26, 1762.

**BAUTZEN**, a busy city of eastern Saxony, Germany, lying on an eminence on the Spree River, about 40 mi. east of Dresden. With the Ortenburg castle high above the stream, the houses with red, tiled roofs on the slopes, numerous towers and remains of medieval fortifications, it is one of the finest sights in Saxony. On the market place is the 18th century rathaus. Near it is the late-Gothic St. Peter's Cathedral. It was here that, in 1813, Napoleon's army defeated the Russian and Prussian forces. The local industries include carriage building and machine construction. Pop. 1925, 40,335.



**BAUXITE**, a valuable ORE of aluminum, usually earthy in appearance, characterized by a clay-like odor. It is white, yellow and to red and brown in color, depending on its purity, and occurs in grains, spongy masses and clay-like beds. Chemically it is the oxide of aluminum with two molecules of water of crystallization.

Bauxite is the product of the WEATHERING of rocks containing minerals high in aluminum, such as the feldspars. The principal bauxite mining areas in the United States are in Arkansas, where the weathering of SYENITE has produced beds of bauxite sometimes 35 feet thick. It is the principal ore of aluminum, and is used in the manufacture of aluminum salts, and to make bricks for furnace linings. It is named after Baux, a town near Arles, France. *See also* ALUMINA; CRYOLITE; ORE DEPOSITS; FELDSPAR.

**BAVARIA**, the second largest German free state in area and population, embracing most of southeastern Germany. In addition, the state includes the Bavarian Palatinate which is separated from the main body by Baden and Hesse and lies east of the Rhine. Bavaria proper has an area of 27,210 sq. mi. and the Palatinate, without the Saar district, 2,124 sq. mi., making a total area of 29,334 sq. mi. The provinces comprising Bavaria are Upper and Lower Bavaria, the Palatinate and the Upper Palatinate, Upper, Lower and Middle Franconia and Swabia. In 1920, the former Free State of COBURG was united with Bavaria.

In the south, the Alps are as high as 9,000 to 10,000 ft.; the rest of Bavaria proper, except the valley of the Main River, is tableland over 1,000 ft. high with mountain ranges reaching to 3,000 ft. Most of the country is drained by the Danube and its tributaries. The meandering Main River drains Upper and Lower Franconia. The Palatinate is bounded on the east by the Rhine. About 695 mi. of the rivers of Bavaria are navigable, as well as the canal between the Rhine and the Danube. Bavaria is rich in picturesque lakes, the largest being Lake Constance and the most beautiful the Königssee near Berchtesgaden. The Bavarian tableland has a relatively raw climate for Germany in contrast to the warm temperature around Lake Constance. There is a similar contrast in the north between the warm Main valley and the colder highlands.

Bavaria has non-technical universities at Munich, Würzburg and Erlangen, and a technical university at Munich, which is a noted cultural center.

Bavaria is a predominantly agricultural state, about 50% of its total acreage being tilled, while one-sixth is under grass and one-third forests. Grain is grown extensively in the lower parts, as are vegetables of many sorts. Cattle raising is carried on in the Alps. Coal is the main mineral, 2,211,859 metric tons being mined in 1929; large quantities of iron ore, sulphuric acid and pig and cast iron also are produced. Extensive water-power resources are a source of Bavaria's industrial wealth, which is chiefly derived from the manufacture of woolens, cottons, glass, porcelain, clocks, wooden ware and pottery. The brewing of

beer is a leading Bavarian industry. Imports include oil, tobacco, coffee and sugar.

Bavaria was established a free state in 1919. The Diet consists of one chamber, the 128 members being elected for terms of four years. The people possess supreme power and universal suffrage prevails.

Pop. 1925, 7,379,594. In Bavaria proper, Catholicism predominates and in the Palatinate, Protestantism. The largest cities are MUNICH, the capital, NÜRNBERG, and AUGSBURG. X.

## HISTORY

Bavaria was conquered from the Celts, 15 B.C., by the Romans, who founded the important cities of Augsburg, Ratisbon and Passau. In the 4th century the area was occupied by Germanic tribes known as Boiarii or Baiuvarii, whence the name Bavaria. From the middle of the 6th to the latter part of the 8th centuries Bavaria was ruled by a Frankish ducal family, the Agilolfings. Christianity was introduced by Rupert, Bishop of Worms, in the 7th century, and firmly established by Boniface in the 8th century. From 800-1500 the Duchy of Bavaria was the scene of continual warfare and feud. Until the end of the 12th century it was ruled by a variety of houses, not one of which really had the welfare of the region at heart. Then in 1180 the Emperor Frederick I took the duchy away from his rebellious vassal Henry the Lion and gave it to Otto of Wittelsbach, whose family remained on the throne until the German Revolution of 1918.

During and after the period of the Reformation Bavaria gradually emerged as one of the strongest Catholic states of Central Europe. During the THIRTY YEARS' WAR it supported the Catholic emperor and was rewarded, in 1623, by being raised to the dignity of an electorate. In 1628 it was also enlarged through the acquisition of the Upper Palatinate. During the 18th century, however, Bavaria was engaged in a long struggle for supremacy with the Austrian Habsburgs, and indeed, from 1742-45 Duke Charles Albert succeeded in wresting the imperial crown from his rivals, becoming Emperor Charles VII. When the Bavarian Wittelsbachs died out in 1777 the duchy, by an agreement of 1329, passed into the possession of the Palatine-Wittelsbachs founded in 1214. This disposition, however, first required a conflict with Austria known as the War of the Bavarian Succession, 1778-79.

During the Revolutionary and Napoleonic periods Bavaria behaved so opportunistically as to be made a kingdom, 1806, by Napoleon and to be permitted to retain this dignity by the Congress of Vienna. From 1815-50 Bavaria attempted to control the balance of power between Austria and Prussia in their struggle for supremacy in the Germanies, and after 1850 Bavaria vigorously opposed the unification policies of the Prussian Bismarck. In 1866 the kingdom fought with Austria against Prussia in the SEVEN WEEKS' WAR. Being defeated, however, Bavaria had to cede about 300 square miles of terri-

tory to Prussia and to form a military alliance with the latter. The year 1870 found Bavaria aligned with Prussia against France, and in 1871 she voluntarily came into the new union called the German Empire. From 1871-1918 Bavaria enjoyed special prerogatives in the empire, as befitted her station as the second largest state in the federation.

Nineteenth century politics in Bavaria centered largely in the questions of democratic reform, Ultramontaniam, and heavy taxation. The *Kulturkampf*, or quarrel between Germany and the Papacy, was particularly bitter in Bavaria. Much of the money collected by taxation was used to patronize art and music, Louis I, 1825-48, doing much to beautify his capital of Munich, and Louis II, 1864-86, being a liberal supporter of musical endeavor. The last king of Bavaria, Leopold III, 1913-18, was popular with his subjects, but he too was swept aside in the wave of revolution that swept over Germany late in 1918. The Wittelsbach dynasty was deposed on Nov. 7, and a Bavarian Soviet Republic under the Presidency of the editor Kurt Eisner set up. But Sovietism was short-lived in Conservative Bavaria, and on Aug. 14, 1919 a regular republican constitution was adopted. It provided for a unicameral Parliament, but there is no president of Bavaria. Parliament may be dissolved at any time by a special vote of the people. Bavaria remains the center of Conservatism and Separatism in the German Republic, and both the Kapp Putsch of 1920 and the Ludendorff-Hitler-Kahr Putsch of 1923 originated there. W. C. L.

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**BAY**, in architecture, (1) the portion of a building contained between four adjacent supports, especially in cases where the design is based on the rhythmic repetition of such elements; and (2) a polygonal, rectangular, or curved structure, containing windows, projecting from the exterior wall of a building and supported on the ground. Bays, in this sense, were especially common in the late Gothic and Early Renaissance, or Tudor and Jacobean, architecture of England. At first developed in connection with the dais, or private, raised portion of the great hall of a mansion in order to give more light and the possibility of a little privacy, bays, or bay windows, were subsequently used wherever it was desired to furnish an unusual amount of light, or to accent some particular portion of the exterior design.

**BAYARD, PIERRE TERRAIL**, Seigneur de (c. 1473-1524), French knight and hero of the Middle Ages, was born near Grenoble about 1473. French tradition styles him the knight "*Sans peur et sans reproche*." Bayard distinguished himself in the Italian campaigns of Charles VIII, Louis XII and Francis I. He gained renown at the battle of Verona, at Marignano, and at the defense of Mézières, in France. He was slain at the Sesia River in Italy, Apr. 30, 1524.

**BAYARD**, a remarkable horse owned by the four sons of the legendary Aymon, Duke of Dordona.

Bayard could expand his body to accommodate four riders at a time. He figures also as the mount of Amadis of Gaul in various romances, as Fitzjames's charger in Scott's *Lady of the Lake*, and as belonging to Rinaldo in Ariosto's *Orlando Furioso*. See also **BAYARD**, **PIERRE TERRAIL**, **CHEVALIER**.

**BAYBERRY** (*Myrica caroliniana*), a small shrub of the sweet gale family, native to sterile soils, chiefly near the coast, from Nova Scotia to Louisiana. It grows from 3 to 6 ft. high, with smooth, oblong, highly fragrant leaves, and bears close clusters of small, nutlike fruits, which, when ripe, are encrusted with white wax. In colonial times the fruit was extensively utilized as a source of wax. Along the New England coast, where the shrub is plentiful, the wax is still used in candle-making. Bayberry candles burn slowly, emitting a pleasant balsamic odor. See also **CANDLE-BERRY**; **WAX-MYRTLE**.

**BAY CITY**, a city of southeastern Michigan, the county seat of Bay Co., situated about 100 mi. north of Detroit. The city stands at the head of deep-sea navigation of the Saginaw River, on Saginaw Bay, which is an outlet of Lake Huron. Bus and truck lines, lake steamers, four railroads and the James Clement Municipal Airport afford transportation. Bay City is a market center for a rich farming country in the Saginaw Valley and the "thumb" region of the lower peninsula of Michigan; the chief agricultural products are beans, sugar beets, corn, barley, oats and live stock. Important fishing and lumber interests and valuable coal mines, one of which is within the city limits, add to the industrial wealth. Among the chief manufactures are cranes, shovels, wooden-ware, ready-cut houses, knit goods, carburetors and transformers. The factory output in 1929 was worth \$27,446,302. In 1929 the retail business reached a total of \$35,082,704. Settlements were made in 1836 at Lower Saginaw and Portsmouth. These towns merged to form Bay City, which was incorporated as a village in 1859 and chartered as a city 6 years later. In 1905 Bay City was consolidated with West Bay City. Pop. 1920, 47,554; 1930, 47,355.

**BAY CITY**, a town in southeastern Texas, the county seat of Matagorda Co. It is situated on the Colorado River, 75 mi. southwest of Houston; served by three railroads. The town is surrounded by extensive oil fields. The chief agricultural interests of the vicinity are rice, cotton, figs and livestock. Mattresses, polished rice and machine shop products are the local manufactures. Bay City is noted for its extensive sulphur deposits. The town was incorporated in 1865. Pop. 1920, 3,454; 1930, 4,070.

**BAYEUX**, a town in Normandy, famous for its fine cathedral and for the historic Bayeux Tapestry. The cathedral of Notre Dame embodies the western towers and the arches of the nave of an 11th century church. The latter were decorated in the 12th century, and in the 13th the cathedral was rebuilt. The chapels were completed in the 14th century, and the beautiful central tower was added in the century following. The unusual combination of Romanesque

arches with sculptured Gothic decoration is especially effective. The famous Tapestry, which is in reality a long strip of embroidered linen, is displayed in the former palace of the bishops. It shows 58 scenes of the Norman conquest of England, and is probably of the 11th century. Bayeux is the seat of a cattle and butter market; it also makes porcelain and lace. Pop. 1931, 7,525.

**BAYLE, PIERRE** (1647-1706), French sceptic and philosopher, was born at Carla-le-Comte, near Pamiers, Nov. 18, 1647. He studied philosophy under the Jesuits. Later he attacked the religious dogmatism of both Catholic and Protestant faiths. Bayle advocated the doctrine that moral convictions can exist independently of religious opinions. He died at Rotterdam, Dec. 28, 1706.

**BAYLISS, SIR WILLIAM MADDOCK** (1866-1924), English physiologist, was born at Wolverhampton in 1866. Although he entered the University College in London, in 1881, with the plan of becoming a medical student, he devoted his efforts to physiology, going to Oxford in 1885, and returning to his first alma mater in 1888, there to carry on research for thirty-five years. He was concerned particularly with the phenomena associated with the action of the heart, the nervous mechanisms controlling the activities of various organs, and of circulation of blood and later with the internal secretions. He also studied problems of shock, and in 1914 published a book, *Principles of General Physiology*, adopted throughout the world as a textbook on the subject. He was widely known as one of the greatest physiologists, and was honored by scientific organizations and learned societies by membership and degrees conferred upon him. He was knighted in 1922.

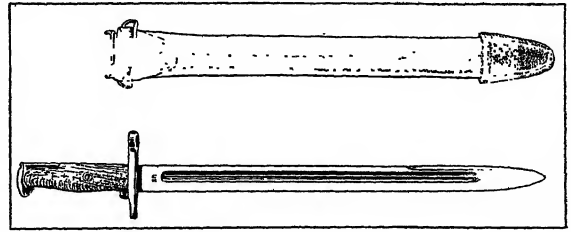
**BAYLOR COLLEGE FOR WOMEN**, at Belton, Tex., was founded as a department of BAYLOR UNIVERSITY at Independence, Tex., in 1845. In 1866, it was separately chartered as Baylor Female College, and in 1886 was removed to Belton. The institution is controlled by the Baptist Convention of Texas. The library contains 26,000 volumes. In 1930 there were 1,272 students and a faculty of 55, headed by Pres. John C. Hardy.

**BAYLOR UNIVERSITY** at Waco, Tex., a co-educational institution, controlled by the Baptist General Convention of Texas. Chartered in 1845 under the Republic of Texas, it was located at Independence until 1886, when it was consolidated with Waco University, at Waco. It has colleges of Medicine, Dentistry and Pharmacy located in Dallas. The library contains 50,000 volumes. In 1930 there was a student enrollment of 1,646, and a faculty of 72 under Pres. SAMUEL PALMER BROOKS.

**BAYONET**, a long knife attachable to the muzzle of a military shoulder rifle for use as a thrusting weapon at close range. When detached, it is usable as a hand weapon, being provided with a convenient handle and guard.

**BAYONNE**, a city of southwestern France, in the department of Basses-Pyrénées, 3½ mi. from the At-

lantic Ocean. Under Roman rule it was a military post and a valuable port, being then called Lapurdum. In the Middle Ages the dukes of Aquitaine held the town, till 1154, when it was captured by the



COURTESY SPRINGFIELD ARMORY, SPRINGFIELD, MASS.

UNITED STATES RIFLE BAYONET AND SCABBARD

English, remaining under English rule till after 1450. It was taken again by the English in 1814 during the Napoleonic Wars. Partly Basque, extremely picturesque, Bayonne has a Basque museum and an art museum; its Cathedral of Ste. Marie in Grand Bayonne is a Gothic work of the 12th-15th centuries. Bayonne is now a busy port, exporting zinc ore, silk materials, wine, brandy, linen and salt. Pop. 1931, 31,727.

**BAYONNE**, a city of Hudson Co., N.J., located on a neck of land between New York and Newark bays. The Kill Van Kull flows between it and Staten Island and Jersey City lies to the north. It is served by the Central Railroad of New Jersey, a system of freight belt lines, buses, and electric trolleys. The vehicular bridge connecting Bayonne with Port Richmond, S.I., is an important connecting link between the Shore and the Philadelphia highway systems and the Holland tunnel. Bayonne has several miles of shore frontage, much of which is occupied by docks and large coal depots. It is the seaboard terminus of many pipe line systems transporting petroleum from numerous oil fields, including those of Oklahoma and Texas, and is one of the leading centers of the world in the refining of petroleum and in the manufacturing of its by-products. There are over 150 industrial establishments with an output in 1929 valued approximately at \$233,000,000. Among the various manufactures are radiators, motor launches, chemicals, cable, waterproof cloth and metal and alloy products. The retail trade in 1929 amounted to \$29,590,891.

The site of Bayonne was discovered by Henry Hudson in 1603 and was settled by the Dutch about 1665. The present city includes the former villages of Bergen Point, Centerville, Bayonne and Pamrapo. It became a separate township from Bergen in 1861, and was chartered as a city in 1869. Bayonne adopted the commission form of government in 1915. Pop. 1920, 76,754; 1930, 88,979.

**BAYONNE DECREE**, a proclamation issued by Napoleon Bonaparte on Apr. 17, 1808, at Bayonne, France, as part of the CONTINENTAL SYSTEM by which he intended to ruin British commerce with the Continent. Upon the objection of the United States,

Napoleon assured that country that the decree would assist in carrying out the provisions of the EMBARGO ACT of Dec. 22, 1807. But the decree, which called for the seizure and sale of all American vessels entering French, Spanish, Italian and Hanseatic ports, allowed the French agents to seize and sell approximately 300 American vessels. The corresponding English measures were one of the chief causes of the WAR OF 1812.

**BAYOU**, a term peculiar to Louisiana, Texas, and Arkansas, signifying strictly a sluggish watercourse originally derived from some other stream or lake. It is now loosely applied to tidal channels near the Gulf, and to streams elsewhere called creeks.

**BAY PSALM BOOK**, a version of the Psalms in meter, prepared and edited by John Eliot, Richard Mather and Thomas Wilde, and published in 1640. It was the first book printed in the British American colonies.

**BAYREUTH**, the capital of Upper Franconia, Bavaria, situated on the Main River about 41 mi. north and east of Nürnberg. It was the residence of the margraves of Brandenburg-Kulmbach, who are responsible for its stately buildings. Its world-wide reputation, however, is owing to RICHARD WAGNER, who lived there until his death in 1883. The Richard Wagner Festival-Theater is an unpretentious building with 1,650 seats. The New Castle was built in Baroque style in 1754-73 and has a large formal garden, near which stands Wagner's house and in the yard of which the composer is buried. In the former Court Church, Margrave Frederick and his consort, Wilhelmina, sister of Frederick the Great, are buried. Pop. 1925, 28,620.

**BAY-RUM TREE** (*Pimenta acris*), a very aromatic tree of the MYRTLE family, found in tropical America. It grows to about 25 ft. in height, bearing large leathery leaves and small white flowers. The oil distilled from the leaves, known as bay oil or oil of myrica, is used in the preparation of bay-rum.

**BAY ST. LOUIS**, a city in southern Mississippi, the county seat of Hancock Co., situated on the Gulf of Mexico, 52 mi. northeast of New Orleans, La. It is served by the Louisville and Nashville Railroad, and by bus lines. The city is a popular winter and summer resort and a shipping center for lumber, pecans, strawberries and vegetables. The French were the first to visit the site in 1699. Pop. 1920, 3,033; 1930, 3,724.

**BAZIN, RENÉ** (1853-1932), French novelist, was born at Angers, Dec. 26, 1853. He became professor of law in the Catholic University at Angers. His *Une Tache d'encre*, a novel published in 1888, won a prize from the French Academy. Many other novels of like charm and literary merit were translated into English. Bazin was admitted to the Academy, Apr. 28, 1904. He died at Paris, July 21, 1932.

**BEACH, AMY MARCY CHENEY** (1867- ), American music composer, was born at Henniker, N.H., Sept. 5, 1867. Her compositions include the *Gaelic Symphony*, *The Minstrel and the King*, for

male chorus and orchestra, and the cantatas, *Festival Jubilate* and *Jephthah's Daughter*. She also composed a Mass in E-flat, the Panama Hymn, and numerous songs.

**BEACH, CHESTER** (1881- ), American sculptor, was born in San Francisco, Cal., May 23, 1881. From 1904-07, he studied in Paris, and on his return to the United States his ability and originality quickly advanced his reputation. He was the designer of the Monroe-Adams, Lexington-Concord, and Hawaiian half dollars. His sculptures include *Fountain of the Waters* and *Twelve Signs of the Zodiac*, Fine Arts Garden, Cleveland; three groups, Panama-Pacific exposition; bronze figure, Barnard College gymnasium, N.Y.; and life-size marbles in the California Palace of Legion of Honor, San Francisco; American Academy of Arts and Letters, New York; Herbert Pratt Estate, Glen Cove, L.I.; Brooklyn Museum; Cleveland Museum; Newark Art Museum; Chicago Art Institute, and St. Mark's Church, New York.

**BEACH, REX ELLINGWOOD** (1877- ), American author, was born at Atwood, Mich., Sept. 1, 1877. He attended Rollins College, in Winter Park, Fla., Chicago College of Law and Kent College of Law, both in Chicago. His works have been chiefly concerned with adventures of the Alaskan gold rush in 1898. Beach was the author of *The Spoilers*, *The Barrier*, *Son of the Gods*, *The Silver Horde*, *Going Some* and *The Ne'er-do-well*.

**BEACH**, the "wave mill" where rock fragments grind at the edge of seas, rivers and lakes. Beaches are progressive, encroaching on a sinking coast, or receding where the coast is rising. Raised beach-lines, far from any body of water, often bear witness to former lake or sea levels.

Broad sand beaches usually form in sheltered crescent bays. A boulder beach may result, as at Winthrop, Massachusetts, from wave attack on the sea-head of a drumlin composed of coarse glacial drift. An offshore beach enclosing a lagoon of quiet water, a common feature of the New Jersey coast, is called a barrier beach.

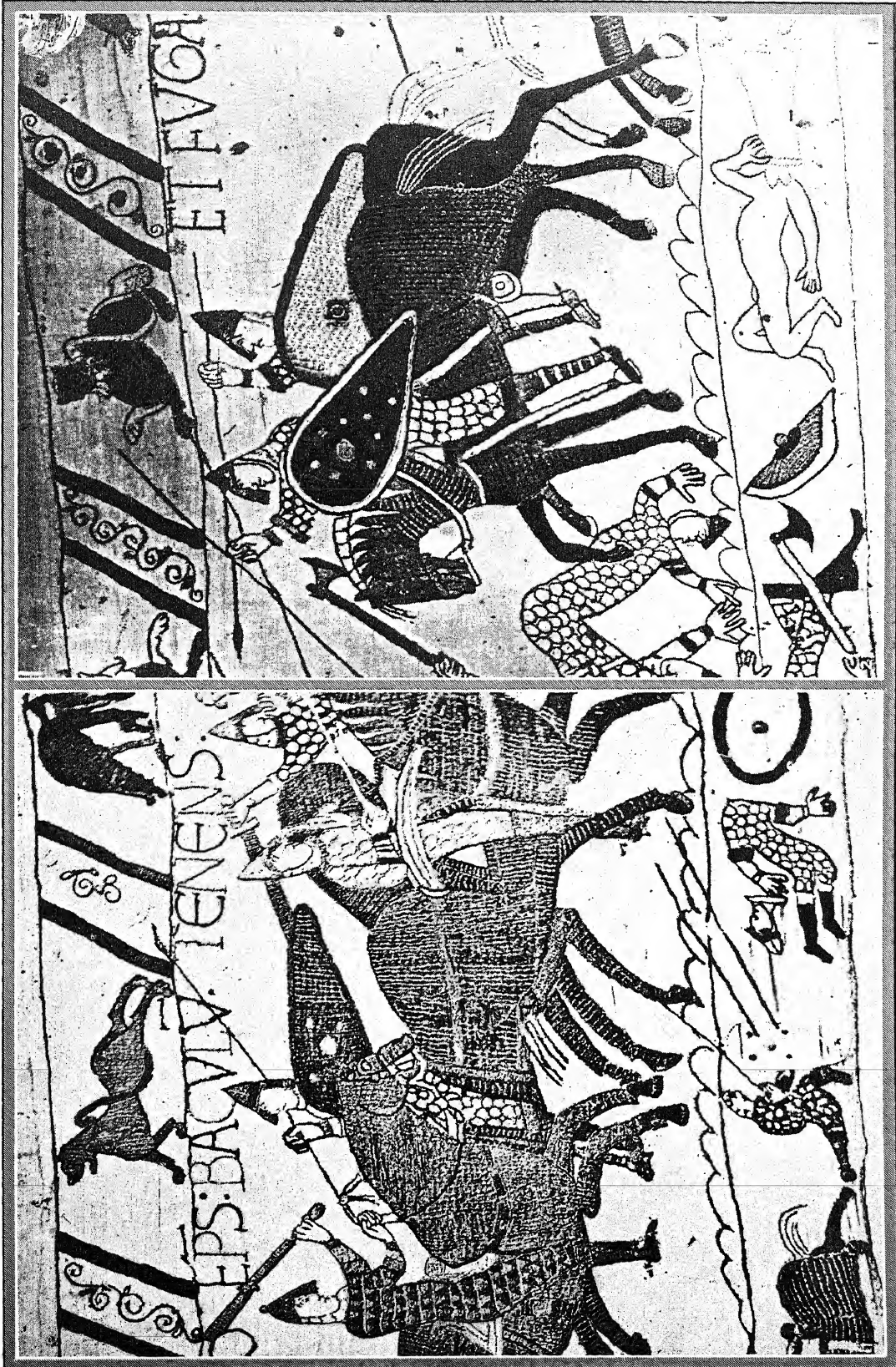
**BEACH GRASS**, a name often given in America to the MARRAM, a vigorous perennial with tough rootstocks much planted along sandy shores to prevent wind erosion.

**BEACH PEA** (*Lathyrus maritimus*), a stout, perennial herb of the pulse family, found on cool sandy ocean shores and along the great inland lakes widely throughout the Northern Hemisphere. It is a trailing or climbing plant, very pea-like in appearance, 1 to 3 ft. high, bearing leaves of 6 to 10 thickish leaflets, and showy purple flowers.

**BEACH WORMWOOD** (*Artemisia Stelleriana*), called also dusty miller, a stout bitter-aromatic, white, woolly perennial of the composite family, found wild on sandy shores along the Atlantic coast and also cultivated as a border plant. It grows about 2 ft. high and bears numerous clusters of small white flowers. Botanically, it is closely allied to the sagebrush.



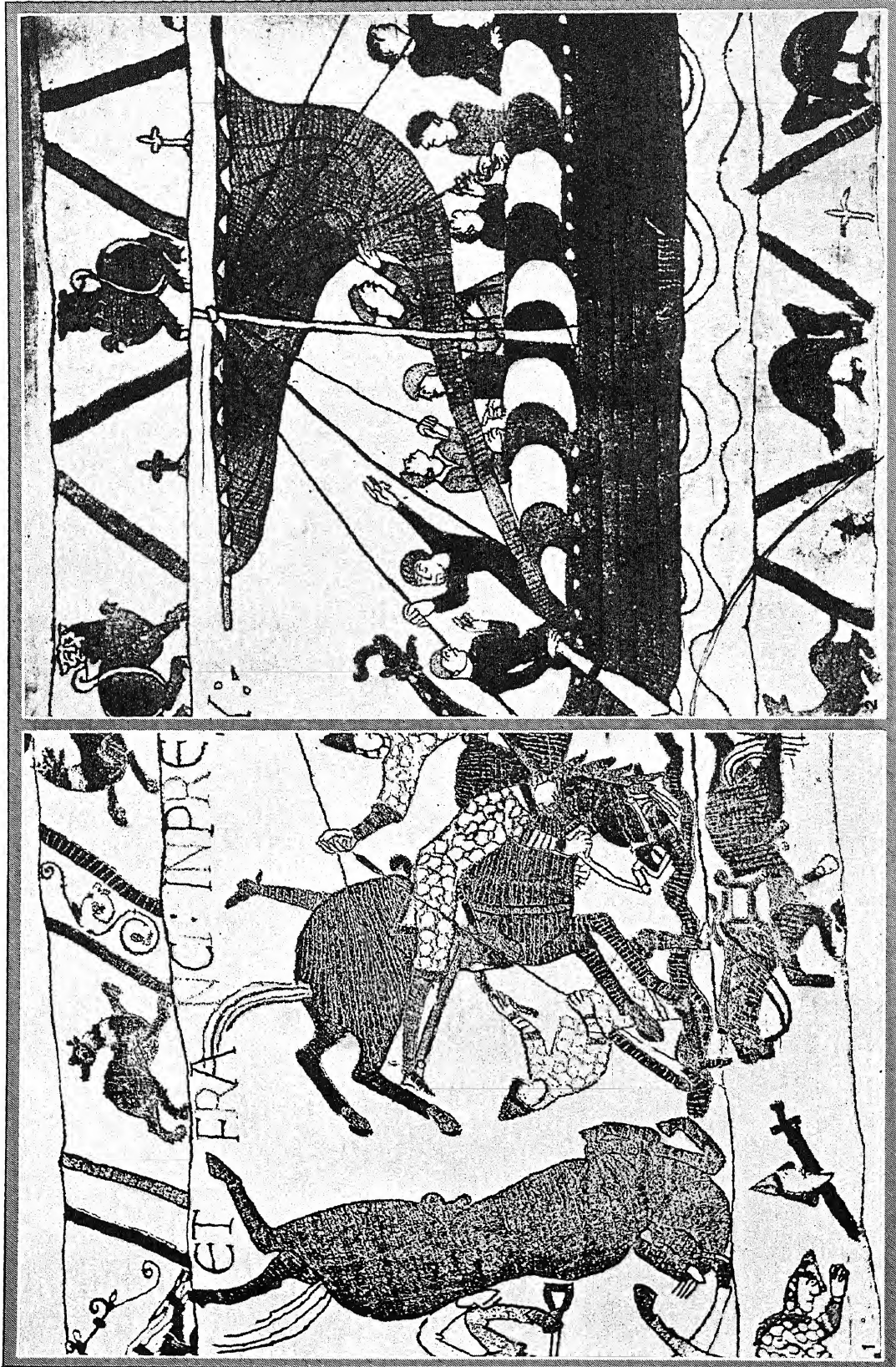
## BAYEUX



### SCENES FROM EARLY ENGLISH HISTORY IN THE BAYEUX TAPESTRY

1. "Bishop Odo, holding a staff, rallies the young troops and came into battle against King Harold." An episode from the famous tapestry believed to have been made by the Queen of William the Conqueror. 2. Another episode: "The English turned in flight." The tapestry is now in the Bayeux Public Library.

## BAYEUX



### EARLY ENGLISH HISTORY DEPICTED IN THE BAYEUX TAPESTRY

1. "English and French fell together in battle," part of the famous 11th century Norman tapestry picturing the Norman Conquest.
2. "Duke Harold returned to England and came to King Edward," another section of the tapestry.



**BEACHY HEAD CAPE**, a promontory in Sussex, England, in the vicinity of Eastbourne. It is a chalk formation, rising 530 ft. at its highest point. The second cliff on the west has been marked since 1831 with a lighthouse. In 1690, the naval Battle of Beachy Head between the English and the French was fought here.

**BEACON**, a city in Dutchess Co., southeastern New York, situated on the east side of the Hudson River, 58 mi. north of New York City; transportation is provided by steamboat lines and by the New York Central and New York, New Haven and Hartford railroads. Beacon is a supply center for summer camps and has various manufactures including bakery machinery, bricks, hats, paint, paper boxes and clothing. In 1929 the total factory output amounted approximately to \$6,000,000; the retail trade amounted to \$5,143,021. It is the seat of several private sanitariums, the Matteawan State Hospital for the Criminally Insane and the United States Veterans' Bureau Hospital No. 98. Beacon was founded about 1709 and was incorporated as a city in 1913. During the American Revolution signal fires were built on the top of Mt. Beacon, back of the city. The Society of the Cincinnati was founded here in 1783. Pop. 1920, 10,996; 1930, 11,933.

**BEACON HILL**, the name of the hill and residential district extending north of Boston Common, Boston, Mass. In the early colonial history of the city a public beacon was set on the hill to warn the people of Indian attacks. Beacon Hill is now con-



COURTESY AMER. MUS. OF NATL. HISTORY

BEADING AN INDIAN MOCCASIN  
Upper, showing rows being sewed over  
the toe

siderably lower than it was formerly and the State House has been built on its summit.

**BEADLE LIBRARY, THE**, a series of novels—the original dime novels—dealing chiefly with American pioneer life, published, beginning in 1860, by the New York firm, Beadle and Adams, founded by

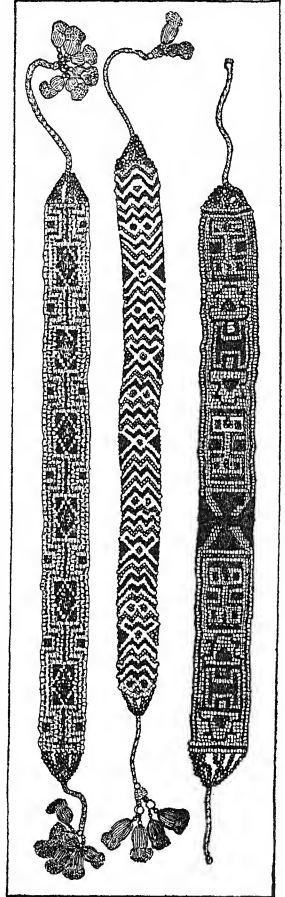
Erastus F. Beadle (1821-94). Beadle's Library, though widely denounced, enjoyed an extraordinary popularity.

Erastus Beadle endeavored to secure only honest writers who knew their subjects at first-hand and could write of them graphically. His editor, Orville J. Victor, was a man of tireless energies and keen discrimination. Among Beadle's early authors were Judge Jared Hall, the historian, C. D. Clark, Mayne Reid, William Eyster, Ann Stephens, Joseph L. Bowen, Francis Barritt and Edward Ellis. When Beadle decided after the Civil War to issue a series of Western novels, he enlisted the services of actual scouts and pioneers. Such unanalytical men of action as Buffalo Bill, Capt. "Bruin" Adams, Dr. Frank Powell, "Buckskin Sam" Hall, Joseph Badger, Oll Coomes, "Texas Jack" Omohundro and Prentiss Ingraham reproduced for the Beadle series the full flavor of the frontier, with its "manly men, its womanly women."

**BEADS**, in modern use, small perforated balls strung on thread and generally used for ornament. They may be made of metal, glass, wood, ivory and other materials, and strung to form a necklace or bracelet. Often beads are sewed individually to cloth for decoration or are set in close rows to make a type of embroidery. In the form of a ROSARY, beads are used in counting prayers.

Beads were used by the earliest of primitive peoples and were often believed to have the power of driving off evil spirits, sickness and disaster. They were crudely shaped from teeth, bones or ivory. Archaeological discoveries in Mesopotamia and Egypt have brought to light many ancient beads made of semi-precious stones frequently carved and ornamented. Glass came to be introduced in their manufacture in Egypt about the 16th century B.C. In the northern countries of Europe and in England the natives carved the ornaments from shell, amber and later from precious metals.

Among the American Indians bead embroidery was preceded by quillwork of prehistoric origin. Porcupine quills were dyed, flattened, folded and carefully



COURTESY AMER. MUS. OF NATL. HISTORY

BEADWORK OF THE SUMA INDIANS OF NICARAGUA

sewed down on hide. Beads of shell came to be used and were made to form WAMPUM, the Indian money. With the introduction of glass beads by colonizers in the 16th century, the savages wove beautiful embroidered designs for moccasins, pouches and ceremonial regalia. Cloth superseded skin as the necessary backing for the beads. Many of the geometric patterns and animal symbols woven into this bead embroidery were believed to exercise a profound protective influence over the wearer.

**BEAK**, a name usually applied to the horny bill of a bird, but also used for similar formations which characterize the mandible-ends of turtles and the duck-bill platypus. Certain insects also have elongated sucking mouths called beaks. In birds, the form of beak varies according to the habits and foods; the falcon's beak is hooked, the flamingo's curved, others are exaggeratedly long. Because of the hard, piercing quality of this horny sheath the word has come to be used for other purposes, the most usual being in connection with ancient war galleys. A metal-cased beam with pointed end which projected from the prow of such a vessel was used to pierce an enemy craft; later the word was sometimes used for an ornamental prow. It is also applied to a carpenter's tool, the spout of a vessel, a spit of land and the horn of an anvil. In classic architecture, a beak runs along the edge of a cornice to make rain drip outward. In early forms the word is spelled *becke* and *beke*. The French and Celtic form was *bec*. G. E. F.

**BEAL, GIFFORD REYNOLDS** (1879- ), American artist, was born at New York City, Jan. 24, 1879. He studied under Chase and Du Mond. Among the honors accorded his landscape, marine and figure paintings are medals and awards of money from the National Arts Club, the Carnegie Institute, the Corcoran Art Gallery and the Philadelphia Arts Club. Beal's *Mayfair* and *The Albany Boat* are in the Metropolitan Museum, New York. *The Puff of Smoke* and *Freight Yards, Hudson River*, are other well-known examples of his work.

**BEALE, DOROTHEA** (1831-1906), English educator, was born at London, Mar. 21, 1831. She studied at Queens College, London, and in 1858 became principal of the Ladies' College at Cheltenham, which school grew and improved under her direction. Miss Beale saw the importance of training schools for teachers and helped to establish St. Hilda's College at Cheltenham for that purpose. She died at Cheltenham, Nov. 9, 1906.

**BEAN**, the name given to plants of various genera of the pulse family as kidney bean (*Phaseolus vulgaris*), lima bean (*P. lunatus*), scarlet runner (*P. multiflorus*), adzuki bean (*P. radiatus*), broad bean (*Vicia Faba*), hyacinth bean (*Dolichos Lablab*), soy bean (*Glycine hispida*), velvet bean (*Stizolobium Deeringianum*) and others.

So-called garden and field beans belong to the kidney group and are either bush or pole varieties, having seeds of various colors, white, black, red, brown or

mottled. In each section are green and wax or butter (yellow) podded varieties. They are alike in their cultural requirements, mellow, fairly rich well-drained soil, full sun, warm weather, except that the pole varieties, including scarlet runners and limas, need richer soils and brush, poles or trellises on which to clamber.

All beans, except the broad, are tender and seed must not be sown until danger of spring frost has passed, nor so late that early autumn frost will kill the plants before the pods or the beans reach edibility. Pole varieties require a long season to mature but bush kinds may be sown successionally at intervals of about two weeks until within eight or, with quick maturing varieties, within even six weeks of usual fall frost date.

Although bean culture is simple, two points must be observed. The pods, when immature ones are desired, must be gathered as soon as they reach edible size, thus encouraging the formation of more pods and the plants must not be disturbed while wet with dew or rain, because various diseases are spread by movements at such times. When immature shell beans are desired, all pods must be left on the plants

#### DRY EDIBLE BEAN PRODUCTION, U.S.,

4-Year Average, 1927-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES . . . .	1,838,000	19,166,000	100.0
LEADING STATES:			
California . . . . .	326,000	5,742,000	30.0
Michigan . . . . .	654,000	5,313,000	27.7
Colorado . . . . .	331,000	2,302,000	12.0
Idaho . . . . .	91,000	1,968,000	10.3
New York . . . . .	94,000	1,125,000	5.9
New Mexico . . . . .	215,000	1,061,000	5.5
Montana . . . . .	48,000	643,000	3.4
Wyoming . . . . .	26,000	492,000	2.6

#### LIMA BEAN PRODUCTION, U.S.,

4-Year Average, 1927-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES . . . . .	6,048	409,000	100.0
LEADING STATES:			
Intermediate—			
New Jersey . . . . .	2,950	226,000	55.3
North Carolina . . . . .	795	32,000	7.8
Early—			
Georgia . . . . .	935	50,000	12.2
South Carolina . . . . .	588	38,000	9.3

#### SNAP BEANS, COMMERCIAL PRODUCTION, U.S.,

4-Year Average, 1927-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES . . . . .	91,317	7,542,000	100.0
LEADING STATES:			
Florida . . . . .	24,837	1,738,000	23.0
New Jersey . . . . .	11,575	1,345,000	17.8
Louisiana . . . . .	8,573	597,000	7.9
Texas . . . . .	6,602	506,000	6.7
Nor. Carolina . . . . .	5,345	453,000	6.0
California . . . . .	2,892	399,000	5.3
Maryland . . . . .	4,542	391,000	5.2

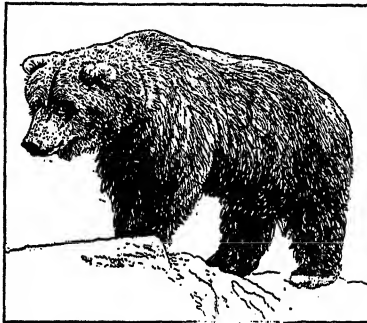
until approximately mature, but not long enough for the beans to become hard; when grown for ripe beans, the plants must drop their leaves before being pulled. Then they may be piled loosely for drying and threshed when they become brittle.

Lima beans require a longer season and a richer soil than garden beans. The pole varieties are large plants and demand ample space. Some of the dwarf limas also are larger than those of garden beans and need more liberal space.

M. G. K.

**BEAN, BROAD**, a stout, leafy, erect annual plant (*Vicia Faba*), of the pulse family, presumably native to southwestern Asia, known also as English, Dwarf, Windsor or Horse Bean. It has been widely grown from prehistoric times in the Old World for fodder and for its seeds which resemble lima beans in size and flavor, but mature much earlier. In America it is less grown, though popular in California and the Canadian Maritime Provinces. Seed must be sown in earliest spring; when sown late, hot weather stunts the plants and blister beetles (*Epicauræ*) eat the flowers so that no pods form.

**BEAR**, the popular name for members of a widely distributed family (*Ursidæ*) of the order Carnivora. They belong to the same sub-order (*Arctoidea*) as dogs, racoons, badgers, skunks, weasels, and a number of less common animals. The bear family (*Ursidæ*), which contains seven distinct genera, is represented on every continent but Australia. Its smaller species are about the size of big dogs, while the largest, the Kodiak brown bear, is 9 ft. in length. Polar bears, Alaska brown bears and grizzlies are the



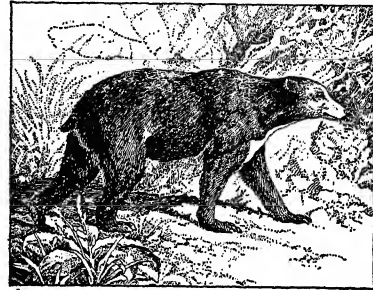
ALASKA BROWN BEAR  
(*Ursus gyas*). Found in the Alaska Peninsula

largest land-living carnivores. However, contrary to popular opinion, they are not under ordinary circumstances dangerous to man.

Bears are characterized by their thick-set, rather clumsy bodies, relatively short legs, and stubby tails. Their claws, unlike those of the cats, are non-retractile. They are omnivorous feeders. Most species depend largely on roots, berries, grubs, ants, grain, fish and occasional small animals, and they are very fond of sweets. The grizzlies and the polar bears are more distinctly carnivorous, while the Malayan bears or burangs live chiefly on honey. In temperate lands the bears eat more meat than usual in the fall, be-

cause at that time they are laying up a store of fat in preparation for their winter period of hibernation.

In North America the most familiar species is the black bear (*Euarctos americanus*) which, before the country became so populous, was found in the woods throughout the continent. This species is of medium



MALAY BEAR

size. Black bears may be readily tamed. Indeed, in the national parks, where they are protected, they seem to tame themselves and it is common to find them along the highways hoping to receive candy from passing motorists. The cubs, of which there may be two or three, are born during the winter, while the mother is hibernating. At birth they are naked and blind, and only about 8 in. long. Another common species is the brown bear (*Ursus arctos*) of northern Europe, Asia and Alaska. It is very tractable, and can be trained to dance.

The white polar bears (*Thalarctos maritimus*) are perhaps the most attractive members of their family. They are more gracefully proportioned than the other species, and are notable for their amazing agility in the water, where they pursue seals, walruses and fish.

**BEAR**, in the stock exchange, a person who believes that current elements affecting a particular Stock or commodity or the entire market, promise lower prices and who sells short in accordance with that belief. Bears are market pessimists who believe conditions are growing worse. **SHORT SELLING** has been attacked on the ground that it serves to depress prices but has been upheld by law. See **BULL**.

**BEAR BAITING**, an early English sport in which a bear was chained to a stake and set upon by a pack of dogs. The chain was just long enough to permit the bear freedom in turning, but not sufficient to allow him any room to make charges. The custom appeared as early as Henry II as a rude rural amusement indulged in when a chance bear was captured. Under the Tudors and early Stuarts it was a full fledged popular amusement carried out in especially constructed bear pits and bear gardens with paid admission and extra attractions such as cock fighting, bull and pony baiting. In the early days the dogs were often allowed to kill the bear; but when there were established proprietors of bear shows this was no longer permitted. The Puritan Republic forbade bear baiting; but it was revived during the Restoration and did not die out until early in the 19th century. The sport was made illegal in 1835.

**BEARBERRY** (*Arctostaphylos Uva-Ursi*), a small shrub of the heath family, found widely on dry sandy or rocky soils in northern regions. The trailing, much branched stems give rise to smooth, thick evergreen leaves, small clusters of whitish flowers, and a red, berry-like, inedible fruit. The smaller Alpine bearberry (*A. alpina*), found in high altitudes, bears a black edible fruit.

**BEARD, CHARLES AUSTIN** (1874- ), American historian and political scientist, was born at Knightstown, Ind., Nov. 27, 1874. He received degrees from DePauw, Oxford, Cornell and Columbia universities and was professor of politics at Columbia from 1915-17. In 1922 Beard was advisor to the Institute of Municipal Research in Tokio, and after the earthquake in Japan in 1927 was advisor to Viscount Gato, Japanese minister of home affairs. He is the author of many works on history and economics.

**BEARD, DANIEL CARTER** (1850- ), American author, artist and founder of the first Boy Scout Society, was born at Cincinnati, O., June 21, 1850. He illustrated for *Harper's*, *Century*, *Scribner's* and other magazines, organized the first class for animal drawing in the world. He is the author of many books on the outdoors. The English Boy Scout movement was modeled after his original Scout Society. Beard acted as National Scout Commissioner and Honorary Vice-president of the Boy Scouts of America. Mt. Beard, adjoining Mt. McKinley, is named for him.

**BEARDSLEY, AUBREY VINCENT** (1872-98), English artist, was born at Brighton, Aug. 24, 1872. At the age of 11 he appeared in concert as a musical phenomenon. He entered an architect's office in 1888 but, urged by Sir Edward Burne-Jones, he adopted art as a profession. Beardsley became a unique artist in black and white. His work was tinged with the "decadence" of the '90s, and he paid little attention to the conventional rules of drawing. The artist did his most memorable work for the *Yellow Book*, and in his illustrations for Jonson's *Volpone*, Wilde's *Salome* and Pope's *Rape of the Lock*. Beardsley died at Mentone, France, Mar. 16, 1898.

**BEARDSTOWN**, a city in Cass Co., western Illinois, on the Illinois River, 46 mi. northwest of Springfield. River craft, bus lines and two railroads serve the city, which is a shipping point for grain, potatoes and melons produced in the vicinity. Beardstown has flour and feed mills. The old court house where Abraham Lincoln defended "Duff" Armstrong for murder, in 1858, is now the city hall. About 20 mi. east is Old Salem State Park, the site of the village where Lincoln lived from 1831 to 1838. Beardstown was founded about 1829 and incorporated in 1896. Pop. 1920, 7,111; 1930, 6,344.

**BEARD-TONGUE** (*Pentstemon*), the name given to a group of showy perennials of the figwort family, native chiefly to the western United States, several of which are fine garden ornamentals. *See also* PENTSTEMON.

**BEAR-GRASS**, the name given to a strikingly handsome plant of the lily family which blooms with

great profusion on mountain slopes in the northwestern United States. *See also* TURKEY-BEARD.

**BEARING METALS**, the parts of machinery bearings comprising the rubbing surfaces; including BABBITT METAL used as linings, and other metals such as BRASS, BRONZE, or even cast iron, which may be in the form of bushings, or in more massive form as the main part of the bearing assembly. Under ideal conditions there would be an unbroken film of lubricant between the shaft and the bearing surface, when the character of the bearing metal would be of little importance. However, in practice, continuous and perfect lubrication is not maintained and the bearing metal must be carefully chosen to cover the particular requirements, depending upon pressure, speed, precision of fit and alignment, and other conditions. Suitable bearing metals for specific conditions will vary from comparatively soft metal linings as, for instance, in freight car journals, to bearings of great hardness, giving least frictional resistance, which can be used where there is high precision of fit, as in jewelled watches. (*See also* BABBITT METAL; BEARINGS.) W. A. C.

**BEARINGS, PLAIN**, supports for revolving SHAFTS or SPINDLES. They are of babbitt, bronze or other metals in contact with the shaft. Many alloys of copper, tin, lead, zinc and antimony are used under various conditions. They are also made of wood, impregnated with oil or graphite, or graphite supported or combined with other materials, and also of other materials in various combinations. Hard rubber is sometimes used, as in propeller shaft bearings. *See also* BALL BEARINGS; ROLLER BEARINGS.

**BEAR MOUNTAIN BRIDGE**, a suspension structure over the Hudson River, above Peekskill, and 44 mi. north of New York City, begun in 1923 and opened for use the following year although it was not completed until 1925, at a cost of \$5,000,000. The bridge has a span of 1,632 ft., supported by steel towers 355 ft. high, that rise from four concrete piers. The roadway, over which pass four lines of vehicular traffic and two pedestrian walks, is supported by two steel-wire cables 18½ in. in diameter. The approach span from the east, crossing the tracks of the New York Central Railroad, and the west approach, spanning the West Shore tracks, are both 210 ft. in length. In the center of the span the roadway has a water clearance of 153 ft. The total weight of the structure, which is one of the important connecting links between New York City and the western part of the state, is 12,562 tons. Tolls are collected by the Bear Mountain Hudson River Bridge Company, which in 1955 will transfer the property to the state.

**BEAT**, in music, the up, down and lateral stroke of a conductor's bâton, to direct the time and accent for a soloist, chorus or orchestra, the more common beats being in 2-4 or 4-4 time, as in a march, and in 3-4, as with a waltz movement. More complicated are combinations requiring five or seven beats to a measure. Mechanical beats of all descriptions are also given by the METRONOME.

**BEATIFICATION**, an ecclesiastical term indicating the first of the two proceedings whereby a saint is solemnly recognized as such by the Catholic Church. The final proceeding is CANONIZATION.

**BEATITUDES**, those statements of Jesus in the Sermon on the Mount which show the special blessedness of certain conditions of human experience. As set forth in the Gospel according to Matthew 5:3-11, the blessed are the poor in spirit, they that mourn, the meek, those that hunger and thirst after righteousness, the merciful, the pure in heart, the peacemakers and all who are persecuted for righteousness's sake. A variation is given in Luke 6:20-22.

**BEATRICE**, the beloved of DANTE and a central figure in the poet's *Vita Nuova* and *The Divine Comedy*. Beatrice was first identified by BOCCACCIO with Beatrice Portinari, the daughter of a wealthy Florentine and the wife of Simone dei Bardi. Dante, who first saw Beatrice when she was nine years old, found in her a life-long source of inspiration.

**BEATRICE**, a city in southeastern Nebraska, the county seat of Gage Co., situated on the Big Blue River, 40 mi. south of Lincoln. Three railroads and bus lines afford transportation. This district is excellent for farming and dairying. Beatrice is a manufacturing center, producing farm equipment and machinery, store fixtures and furniture. The city has large creameries. In 1929 the retail trade was valued at \$9,472,323. Here the first homestead under the Homestead Act was taken up in 1863. Beatrice was incorporated in 1873. Pop. 1920, 9,664; 1930, 10,267.

**BEATS**, the fluctuation in noise intensity which occurs when two sounds of nearly the same pitch are produced simultaneously. For example, if two TUNING FORKS are tuned exactly to unison and then the prongs of one loaded with small bits of wax, a throbbing effect will be observed when the two are sounded together, due to the fact that the PITCH of the loaded fork has been slightly lowered. Suppose that both forks initially made 200 vibrations per sec. and that the loading reduced the FREQUENCY of one of them to 199 vibrations per sec. Then the beats will have a frequency of one per second, i.e., the *beat frequency* is equal to the difference in the frequencies of the two generating tones. If the difference of frequency is 2 vibrations per sec., then they will be out of step twice in a second, and so on.

If the beats become so rapid that the ear no longer recognizes the individual fluctuations, the effect becomes unpleasant and discord results. However, if two intense, high-pitched tones of different frequencies be sounded together, the ear will perceive an additional low-pitched tone whose frequency is the difference in the generating frequencies. Such a tone is called a *beat tone*. The heterodyne principle (see HETERODYNE RECEPTION) in radio reception is based on the production of audible beat tones by the combined action of two radio frequencies that are far above the frequency-response range of the receiving apparatus. Thus, if a *radio frequency* of 100,000

cycles and one of 99,000 cycles be impressed on a suitable electrical circuit, a *beat frequency* of 1,000 cycles will be generated.

P. E. S.

**BEATTIE, JAMES** (1735-1803), Scottish essayist, poet and philosophical writer, was born at Lawrence-kirk, Oct. 25, 1735. In 1760 he was professor of moral philosophy in Marischal College, his Alma Mater, at Aberdeen, and in 1770 he published his *Essay on Truth*, a challenge to the scepticism of Hume. *The Minstrel* is generally considered his best poem. Beattie's essays are highly regarded for their clear, elegant style. He died at Aberdeen, Aug. 18, 1803.

**BEATTY, DAVID** (1871- ), British naval commander, first earl of the North Sea, was born at Borodale, Wexford Co., Ireland, Jan. 17, 1871. He joined the British navy in 1884 and served with the Nile flotilla in 1896. In 1900 he took part in the advance on Peking and in 1908 was aide de camp to King Edward VII; in 1910 he was promoted to the rank of rear-admiral at the early age of 39. At the outbreak of the World War he was given an independent command and distinguished himself at the naval battles of Heligoland Bight, Sept. 28, 1914, Dogger Bank, Jan. 24, 1915 and Jutland, May 31, 1916. In Dec. 1916 he succeeded Sir John Jellicoe as commander of the Grand Fleet and in 1919 at the close of the World War he was given an earldom and \$500,000 for his services, and made First Sea Lord. He is married to the American heiress Ethel Field, only daughter of Marshall Field of Chicago, by whom he has two sons.

**BEAUFORT SCALE**, a method of expressing numerically the strength of the wind, in which the number 0 stands for calm, and 12 for a hurricane, the strongest and most destructive wind known. It was named after Admiral Sir Francis Beaufort, who first proposed it in 1806. Wind strength on the Beaufort scale depends upon individual estimates, and as such is not directly comparable to the velocities measured accurately with the anemometer. The approximate relationship between the two and the ordinary nautical description are given in the following table:

Beaufort Scale	Name	Velocity (miles per hour)
0	Calm .....	less than 2
1-3	Breeze .....	2-12
4-5	Moderate wind .....	13-22
6-7	Strong wind .....	23-33
8-9	Gale .....	34-48
10-11	Storm .....	49-65
12	Hurricane .....	more than 65

Similarly, the Beaufort Notation expresses the general weather conditions by indicating each particular item such as clouds, rain, fog, thunder, etc. by one letter.

**BEAUMARCHAIS, PIERRE AUGUSTIN CARON DE** (1732-99), French dramatist and poet, was born at Paris, Jan. 24, 1732. He attained proficiency in music, his ability soon securing him ad-



mission to court. His first play, *Eugénie*, 1767, was successful. His *Mémoires* in prose gained for him a reputation for satire and logic. Beaumarchais is best remembered for his two comedies, *Le Barbier de Seville*, 1775, and *Le Mariage de Figaro*, 1784. He was the seventh son of Charles Caron, a watchmaker, and adopted the name of Beaumarchais. He died at Paris, May 18, 1799.

**BEAUMONT, FRANCIS** (1584-1616), English dramatist, was born at Grace-Dieu, Leicester, in 1584. He was the youngest son of Sir Francis Beaumont, Justice of the Common Pleas. At 12 he entered Broadgates Hall, Oxford, but left in 1600 without a degree, and the same year was admitted to the Inner Temple. About this time he became acquainted with BEN JONSON, and prefixed some laudatory verses to the first edition of *Volpone*, as also did JOHN FLETCHER. Possibly the following close association of Beaumont and Fletcher began with this connection. From about 1600 they collaborated. Then, until Beaumont's marriage in 1613 to Ursula Isley of Sundridge, Kent, the writing of Beaumont is so interwoven with Fletcher's that determining the exact share of either poet's work becomes largely a matter of opinion. *The Knight of the Burning Pestle*, 1613, *Cupid's Revenge*, 1615, and *The Scornful Lady* are acknowledged to be their joint work. *Philastor*, 1620, and *The Maid's Tragedy*, published after Beaumont's death, are considered mainly his authorship, but other plays show the hand of Massinger and other assistants. Beaumont died on Mar. 6, 1616, and was buried in Westminster Abbey.

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**BEAUMONT**, a port city and the county seat of Jefferson Co., southwestern Texas, situated on the Neches River. It has a 30 ft. channel to the Gulf of Mexico. Four railroads, steamships, bus lines and an airport serve as other transportation facilities. The Spindletop oil production started here in 1901; still greater developments about 1926 made the city one of the foremost petroleum centers of the country. Lumber also is an important industry. In 1929 the value of the factory output was about \$12,000,000; the retail trade amounted to \$36,712,422. The Battle of Sabine Pass and the Battle of San Jacinto in the Texas War of Independence were fought in 1836 in the vicinity. Pop. 1920, 40,422; 1930, 57,462.

**BEAUMONT AND FLETCHER.** See BEAUMONT, FRANCIS; FLETCHER, JOHN.

**BEAUNE**, an old town in western France, center of the Burgundy wine district and chief headquarters for that trade, situated on the Bouzoise River, department of Côte-d'Or. The town keeps much of its medieval citadel and several old buildings, and it possesses a unique architectural treasure in its beautiful Hôtel-Dieu, built largely of wood, founded in 1443, and still a hospital. Beaune has some manufactures but the wine trade is the leading industry. Pop. 1931, 11,862.

**BEAUREGARD, PETER GUSTAVE TOUS-SAINT** (1818-93), American general, was born near New Orleans, La., May 28, 1818. He was graduated from West Point in 1838, and won his brevet of captain at Contreras and Cherubusco in the Mexican War. When Louisiana seceded, he joined the Confederates as commander at Charleston, S.C., where, on Apr. 11, 1861, he commenced the Civil War by firing on Fort Sumter. On July 21 he won the battle of Bull Run. He was given command of the army of the Mississippi in 1862, and fought the battle of Shiloh on Apr. 6. In 1863 Beauregard defended Charleston, and in 1864 he aided Gen. Lee in the defense of Richmond. He surrendered his forces to Sherman in 1865. In 1866 Beauregard was offered the command of the Roumanian armies and in 1869 the command of the forces of the Khedive of Egypt, but declined both. From 1865 to 1870 he served as president of the New Orleans, Jackson and Mississippi Railroad, and was made adjutant general of Louisiana in 1878. In ensuing years he managed the state lottery. He died at New Orleans, Feb. 20, 1893.

**BEAUTY CLAYS**, also called beauty masks, mud packs or mud creams, are made chiefly of Fuller's earth, mixed with starch and various minor ingredients to form a paste. They purport to beautify the complexion and help eradicate wrinkles, but their claims, according to various authorities, are hardly justified. Improvement is often noticeable when the mask is removed, especially if the individual has been lying down and resting during the drying period. Also, because the skin has been stimulated, making the blood circulate during the drying process, it shows a temporary improvement.

**BEAUTY CULTURE**, the term applied to the various phases of beauty treatments as practiced in beauty parlors, or salons, and in the home. It usually refers to external treatments for the improvement of the complexion and facial contours. But frequently it also includes the care of the hair, hands, and figure.

The care of the skin to keep the complexion attractive and youthful looking, usually consists of remedial treatments divided into the most common skin complaints such as large pores, blackheads, oily skin, dry skin, wrinkles and blemishes. The contour treatments include those for sagging muscles, scrawny face and neck, and double chin. These treatments vary in detail, according to principles dictated by manufacturers of well-known cosmetics. Every manufacturer of cosmetics for the care of the skin (such as creams and lotions) prescribes beauty regimes based upon what he believes to be most beneficial for the purpose. Naturally, the use of various creams and lotions are recommended as necessary adjuncts to all treatments practised at home or in the beauty salons. (See FACE PREPARATIONS.)

Beauty treatments for the *hair* include the healthy care of the hair and scalp, and, as in the case of the complexion, refers to the remedial type of treatments such as the prevention or overcoming of dandruff and



falling hair, or improving an oily or dry condition. There are lotions, shampoos, and mechanical devices for these various purposes. (See HAIR PREPARATIONS.)

The most important phase of the care of the *hands* is the manicure. There are lotions and creams for keeping the hands soft, but it is in the manicure that a large variety of cosmetic agents is employed. (See HAND PREPARATIONS; MANICURE PREPARATIONS.)

Serious systematic attention devoted to the *figure* is a recent development of the modern interpretation of beauty culture. It is not merely a matter of exercise, but a definite aim to keep the figure youthful and adapted to the current fashions. Salons and studios for this purpose are increasing, some of them a part of the beauty salons heretofore devoted largely to facial care. See also COSMETICS; EYE PREPARATIONS; BEAUTY CLAYS; BATH PREPARATIONS; DENTAL PREPARATIONS; DEPILATORIES.

G. R. F.

**BEAUVAIS**, a historic and picturesque town in northern France, famous both for its tapestries and its cathedral. The low-warp looms of Beauvais were established by Colbert in 1664, and still make tapestries under government sponsorship. Carpet-making is also an industry. Beauvais is the capital of the department of the Oise. It was a British military headquarters in the World War, and suffered from aerial bombardment. Pop. 1931, 18,738.

The Cathedral of St. Pierre at Beauvais, highest in vaulting of all Gothic cathedrals, would have been the greatest in area had it been completed. Begun in 1227, it was designed to be the world's largest, most daring work of Gothic architecture. The high vault fell in 1284, soon after its completion; with better support, it was rebuilt. But a tall spire, added in the 16th century, when the nave had not yet been finished and the buttressing was insufficient, caused another collapse. The plan of completing the nave was then abandoned. Even as it now stands, however, Beauvais equals many an imposing church in size, and its magnificent choir is one of the outstanding achievements of Gothic architecture in France. The vaulting of the choir rises to the extraordinary height of 158 ft., and the windows are 55 ft. high. The choir is more than 120 ft. long. The transepts, finished between 1500 and 1548, have splendid portals, and the carved oaken doors of the south transept are among the finest in existence. The cathedral contains interesting tapestries of the 15th, 16th and 17th centuries, and some exquisite stained glass of the 13th, 14th and 16th centuries.

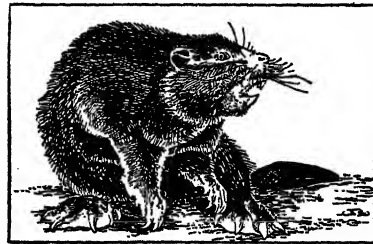
**BEAUX, CECILIA** (1863- ), American portrait painter, was born at Philadelphia, May 12, 1863. She studied under William Sartain and in Paris at the Julian and Lazar schools. From Paris, where she exhibited at the Exposition in 1890, she returned to the United States in 1891. She has been awarded the Mary Smith Prize of the Pennsylvania Academy of Fine Arts four times and has served as director of the American Federation of Arts. One of Cecilia Beaux's best known paintings is *The Girl in White: Ernesta*, in the Metropolitan Museum, New York.

**BEAUX ARTS, ÉCOLE DES**, a French government institution at Paris for the instruction of men and women in the fine arts. It was established in 1793 by the union of the Academy of Painting and Sculpture, founded in 1648 under the patronage of Louis XIV, and the Academy of Architecture, founded in 1671, and came under government control in 1863. Courses are maintained in sculpture, painting, architecture and allied subjects. The various departments confer the *prix de Rome* which entitles the winners to a four-year period of study in Italy. Americans predominate among the foreign students at the school. The enrollment averages around 2,000 students and 50 instructors.

**BEAUX ARTS INSTITUTE OF DESIGN**, in New York, an institution for instruction in the arts of design. It was founded in 1916 by Lloyd Warren as an active educational outgrowth of the Society of Beaux Arts Architects. The institute offers annually a Paris prize of \$3,600 for two and one-half years architectural study, a Paris prize in sculpture of \$1,200, and four scholarships of \$500 for summer study at the Fontainebleau School of Fine Arts. In 1931 there were approximately 3,000 students enrolled.

**BEAVER**, a group of Athapaskan-speaking Indian tribes now occupying the Peace River district from the eastern borders of the Rocky Mountains in British Columbia to the falls on the Peace River, about 40 miles below Vermilion. The Beaver are now divided into three small groups numbering slightly more than 100 individuals in each, living in the vicinity of Fort St. John, Dunvegan and Vermilion. Culturally they belong to the Mackenzie area, living a more or less roving life, in caribou or moose skin tipis, using bark canoes for water transportation, and in winter employing the toboggan and snowshoes. They were skilled hunters, practised agriculture and, in contrast to most Indian tribes, wore tailored skin clothing. Socially they were loosely organized into bands. Neither their ceremonial nor religious life is in any respect striking.

**BEAVER**, the largest aquatic rodent, sometimes being 30 in. long, exclusive of the tail, and weighing 60 lbs. Formerly found all over northern Europe, the



AMERICAN BEAVER

Old World beaver (*Castor fiber*) is now probably extinct except in Scandinavia. The American beaver (*Castor canadensis*) played a great part in the settling of the country, since its fur, the standard of the trade, took the place of currency. At one time the beaver

became almost extinct, but now, through careful protection, it is abundant in some regions. Beavers reproduce rapidly, if given a chance.

The beaver is especially noted for its engineering ability, building dams of sticks and mud to provide ponds, and lodges to live in. Green soft logs, especially poplar and birch, are plastered with mud brought from the bottom in the animal's forepaws. The dome-shaped lodge is built in the same manner; just before winter begins it is given a coat of mud which freezes hard and protects the den from wandering animals. As many as 12 adults and young live in one lodge, which, enlarged from time to time, may be 5 or 6 ft. high.

Beavers work mostly at night, but may swim in the pond or even cut trees by day, especially in cloudy weather. The chief food is soft bark, in the summer varied with grasses and other plants. Trees of considerable size are felled and the branches, cut to suitable lengths, towed to the water and sunk near the lodge, one end stuck in the mud. This gives the winter food supply. When the bark has been stripped off, the branch is added to the dam.

Beaver "castors" are two glands situated in the anal region. Like those of a musk deer, they are used in perfumery.

**BEAVER**, a borough and the county seat of Beaver Co., western Pennsylvania, situated at the junction of the Ohio and the Beaver rivers, 27 mi. northwest of Pittsburgh. It is served by two railroads. Beaver is chiefly a residential community. There is a planing mill. Settlement began about 1790. Pop. 1920, 4,135; 1930, 5,665.

**BEAVERBROOK, WILLIAM MAXWELL AITKEN**, First Baron (1879- ), was born at Newcastle, N.B., Canada, May 25, 1879. He was educated in the public schools at Newcastle and made a spectacular success in early business ventures. Retiring from business Beaverbrook entered English politics, winning a seat in Parliament in 1910, becoming private secretary to Bonar Law. He was knighted in 1911, and created baronet in 1916. He represented the Canadian Government at the front in the World War. After the Armistice, he resigned from the cabinet, abandoned politics and became interested in newspaper work, obtaining the majority stock in *The London Daily Express*. In 1921 he founded *The Sunday Express*. Among his publications are: *Canada in Flanders* in 2 volumes; *Success; Politicians and the Press*, and *Politicians and the War*.

**BEAVER DAM**, a city in Dodge Co., in south central Wisconsin, situated on Beaver Lake, 40 mi. northeast of Madison. Bus and truck lines and two railroads serve the city. Grain and timothy hay are the chief crops of the region; the manufactures include barn equipment, cheese, iron works, stoves, shoes, and hosiery. The city was founded about 1841 and incorporated in 1856. Pop. 1920, 7,992; 1930, 9,867.

**BEAVER FALLS**, a city of Beaver Co., Pa., on the Beaver River, 3½ mi. from its confluence with the

Ohio and about 30 mi. northwest of Pittsburgh. It is served by the Pennsylvania and the Pittsburgh and Lake Erie division of the New York Central railroads, motor bus lines and an airport. It is one of the important manufacturing cities of Beaver valley, where valuable coal-mines and stone-quarries are found. Manufactures are principally iron and drawn steel products, seamless tubing, matting, amusement devices, lumber, barrels, stoves, chemicals, cork, glass, porcelain, tiles, shovels and drills. In 1929 total manufactures were valued approximately at \$21,000,000; the retail trade amounted to \$12,387,040. Geneva College is nearby. Originally called Brighton, Beaver Falls was settled in 1801 and incorporated as a borough in 1868. Pop. 1920, 12,802; 1930, 17,147; about 20% foreign-born and 22% colored.

**BEBEL, AUGUST** (1840-1913), German Socialist, was born at Cologne, Feb. 22, 1840, of a working class family. He became a disciple of Marx early in life and was one of the founders of the Social Democratic Party. A member of the diet of the North German Confederation, he was elected to the Imperial Diet after the establishment of the empire, retaining his seat, except for a short period, until his death. A bitter opponent of Bismarck and the military, he frequently was arrested and on one occasion sentenced to serve two years for treason. A leader of Social Democracy, he was also a journalist on the staff of the *Vorwärts* and an author of considerable ability, writing *Socialism and Christianity*, *The Women of the Past, Present and Future* and other works. He died, Aug. 13, 1913, at Passug, Switzerland.

**BECCARIA, CESARE BONESANA**, Marchese de (1738-94), Italian economist and publicist, was born at Milan, Mar. 15, 1735. He published a tract on currency reform in 1762, and by 1768, when a chair of law and economy was established for him at the Palatine College of Parma, his original work in economics was already celebrated. In 1864 he brought out a treatise, *On Crimes and Punishments*, which was published in six editions in 18 months, and was translated into 22 languages. This book affected the process of criminal-law reforms in many European countries, and the author's *Economic Principles*, published later, influenced economic thought in both England and France. In 1791 Beccaria was commissioned to prepare reforms of the judicial code. He died at Milan, Nov. 28, 1794.

**BECHE-DE-MER** or **TREPANG**, the name generally given to dried edible sea cucumbers (*Holothuroidea*). Most of the species used belong to one genus (*Holothuria*), ranging from 6 to 15 inches in length. They usually frequent fairly deep shore waters along the coast of California and around the South Sea Islands, and are commonly caught by divers.

In preparing bêche-de-mer the flesh of the sea cucumber is boiled and dried. It may then be used to make a thick, nutritious soup, which is very popular in the Orient, especially in China.

Both in the South Seas and in California there is

a considerable industry, carried on to a large extent by Chinese, in catching and preparing the local sea cucumbers. *See also* SEA CUCUMBER.

**BECHUANA**, a group of tribes of Bantu stock living in Orange Free State, British Bechuanaland, Bechuna Protectorate and the Transvaal. They are of medium height and though essentially Negroes, range from medium brown to a yellowish brown due to mixture with BUSHMEN and HOTTENTOTS. Each tribe has its own territory and forms a separate social and political organization under the leadership of a chief who is the center of tribal life. Descent is patrilineal. For livelihood they depend principally upon their flocks of cattle, sheep and goats and upon hoe culture, Kafir corn forming the main crop. Ancestor worship is the basis of their religious beliefs and practices. The Bechuanas live in large villages composed of huts usually circular in shape with thatched roofs and walls of wattle and daub. Serowe, the chief village of the Bamangwato tribe, has a population of 25,000; Molepopole, a Bakwena village, has a population of 9,000. The principal Bechuna tribes are the Bakwena numbering in 1926 approximately 11,000 members; the Batawana with 17,500 members, and the Bamangwato with an estimate of 60,000 members.

**BECHUANALAND**, a British protectorate in the central part of southern Africa, between South-West Africa and the Union of South Africa and Rhodesia; area about 275,000 sq. mi. The relatively small number of inhabitants (152,983 in 1921, of which 1,743 were Europeans), indicates the general aridity of the region, which includes nearly all of the so-called Kalahari Desert. The greater part of the area consists of a grassland with scattered trees, mainly stunted acacia, and of poor pastures whose value varies from year to year according to the rainfall. There is a lack of any surface water and, as Lake Ngami is very shallow and often nearly dry, water is obtained by boring in the river beds. Many plants storing water, including a bulbous water-root, are sought by men and beasts alike.

The natives keep a few cattle, sheep and goats, and produce a certain quantity of maize. The Europeans are chiefly officials, missionaries, traders, and a few farmers and miners. Cattle are raised in small numbers and copper and gold are mined in trifling amounts. Bechuanaland has a fine winter climate but very hot summers; fever is prevalent.

The protectorate is administered from Mafeking, Cape of Good Hope, but a local commissioner is stationed at Francistown. The country has been a British possession since 1885.

**BECKET, THOMAS À** (1118?-70), English cardinal and martyr, was born at London, Dec. 21, 1118(?). His early years were spent at the home of the archbishop of Canterbury, who sent him to Europe to study canon law. Acting for the archbishop of Canterbury, he was successful in certain negotiations with the Pope, in which way Becket came to the attention of Henry II, who in 1155 made him

high-chancellor and preceptor to Prince Henry. For four years he was among the king's intimates, and one of the first courtiers of the land. When the archbishop died, Henry gave Becket the office. Thereupon the former courtier frowned upon the splendors of the court, and became exceedingly austere. As archbishop of Canterbury, Becket's loyalty to the Pope became increasingly apparent, and he opposed Henry on matters involving property rights of the nobles, claiming their lands for the Church. In 1164, he fled to Flanders to escape the consequences of the king's displeasures. A reconciliation was effected in 1170, and Becket returned to his see, with all privileges restored. But his refusal to restore to office the prelates he had suspended during his exile again annoyed the king. The barons took the hint, proceeded to Canterbury, and on Dec. 29, 1170 murdered Becket in the cathedral. He was canonized Feb. 21, 1173. Subsequently the murderers made pilgrimages to the Holy Land in repentance of their deed.

**BECKLEY**, a city of southwestern West Virginia, the county seat of Raleigh Co., situated 78 mi. southeast of Charleston on a plateau of the Allegheny Mountains. Bus lines and two railroads serve the city. Beckley is the metropolis and shipping market for a large timber region and for the celebrated "smokeless" coal fields of West Virginia. Mining is the chief industrial interest; the city is a residential community for the officials of the mines. There are machine shops and mining equipment factories. It was founded by Col. Alfred Beckley in 1837 and incorporated in the same year. Nearby is Grand View, noted for the beauty of the surrounding country. Pop. 1920, 4,149; 1930, 9,357.

**BECKWITH, JAMES CARROLL** (1852-1917), American painter, was born at Hannibal, Mo., Sept. 23, 1852. He specialized in portraits and genre art. Beckwith studied at the École des Beaux-Arts, Paris, and in the studio of Carolus-Duran, returning to the United States in 1878. Among his works are *The Falconer*, *The Authoress* and portraits of many noted Americans. He became a member of the National Academy in 1894. Beckwith died in New York City, Oct. 24, 1917.

**BECKY SHARP**, the chief character in Thackeray's *VANITY FAIR*.

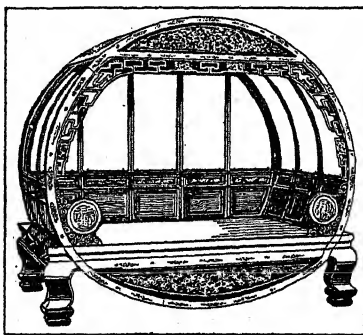
**BECQUE, HENRY FRANÇOIS** (1837-99), French dramatist, was born at Paris, Apr. 9, 1837. His first success was the libretto for the opera *Sardanapale*, produced in 1867. His earlier plays, *Michel Pauper*, eventually produced in 1870, and *The Elopeement*, had been rejected by the public before the success of the opera. His first substantial success as a playwright occurred in 1882 when he obtained production of *Les Corbeaux*. Becque's *La Parisienne*, produced in 1885, marked the beginning of the French natural school of the drama, of which he is the acknowledged originator. He died at Paris, May 13, 1899.

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**BECQUEREL**, surname of members of a French family who are famous for their investigations in the fields of chemistry and the physical sciences. ANTOINE CÉSAR (1788-1878), born at Châtillon sur Loing, France, Mar. 8, 1788. In 1837 he received the Copley medal from the Royal Society in recognition of his memoirs recording his studies in electricity and electrochemistry. Died at Paris, Jan. 18, 1878. His son, ALEXANDRE EDMOND (1820-91), born at Paris, Mar. 24, 1820. He made important studies of light and carried on research in electrochemistry. His *La Lumière, ses causes et ses effets* was published in 1867-68. Died at Paris, May 11, 1891. His son, ANTOINE HENRI (1852-1908), born at Paris, Dec. 15, 1852. He was awarded a Nobel prize jointly with PIERRE CURIE in 1903 for his discovery of radioactivity and subsequent researches. Died at Croisic, Brittany, Aug. 25, 1908.

**BED** (from the same root as the Latin *fodire*, to dig), a place for sleep. Its form has shifted through the ages from the primitive bed of leaves in a dugout to the magnificent carved, gilded and draped pieces of the 17th century, costing sometimes as much as \$40,000, and back again to the sanitary simplicity and inexpensiveness of the open metal bed or canvas cot of to-day. The poor man's bed, until modern times, was a rough box filled with straw.

The ancient Egyptians, Assyrians, Babylonians, Persians, Greeks and Romans of wealth had bedsteads made of rare woods gracefully carved and embellished with gold, silver and ivory, and complete with mattress, pillows, canopy and mosquito net. The Hebrews had such gorgeous beds as to incur the censure of the prophet Amos. During the Dark Ages comforts diminished, until the Crusaders brought back a taste for Oriental luxury. In the medieval castle or manor

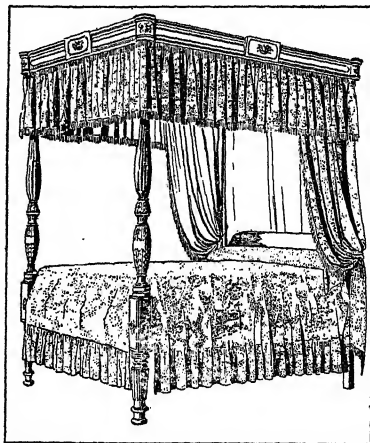


COURTESY M. M. OF ART

CHINESE BEDSTEAD OF ROSEWOOD, 19TH CENTURY

house the bed was the chief article of furniture in the great hall. For privacy and protection against draughts these immense beds were curtained by heavy hangings richly embroidered, sometimes with gold and silver thread, or were boxed in by carved woodwork. The hangings fell from a canopy or tester, supported from the ceiling or side wall, or resting on bedposts. The carving, inlaying, painting, gilding or other decoration followed the changing styles of the dif-

ferent periods. The Restoration designers achieved curious effects by covering the carved wooden bedposts and tester frames with the same material as the bed curtains. Louis XIV had 413 elaborate beds, and



COURTESY M. M. OF ART

AMERICAN COLONIAL BED WITH TESTER

in his day and later it became fashionable to hold receptions in bed.

**BED**, in geology; see STRATUM.

**BEDBUG**, a flat, wingless, blood-sucking household insect (*Cimex* or *Acanthia lectularius*) which preys at night on man. It completes its life cycle in about three months, lays several hatches of eggs and multiplies rapidly. Crevices especially in beds, floors, baseboards, wallpaper and plaster are its favorite hiding places. In hotels and steamships, which are often infested, pyrethrum freely dusted in the bedding will repel it. But to exterminate it requires drastic treatment. Gasoline, benzine, turpentine, wood alcohol, live steam or boiling water, when these are feasible, are sure destroyers but should be repeated twice or thrice at weekly intervals to exterminate young bugs hatched from eggs. Fumigation with poisonous gases is the best of all methods but, because of the extreme danger attending its use, is applicable only to vacant buildings and ships.

**BEDE**, **BEDA** or **BAEDA** (673?-735), English monk and ecclesiastical writer, surnamed "The Venerable," was born at Wearmouth, in Northumberland, about 673. His name is one of the greatest in the ancient literature of Britain. At the age of seven he entered the monastery of St. Peter and St. Paul at Jarrow, where he spent his life. He wrote hymns, epigrams, works on chronology and grammar. Bede is said to have been master of all the learning of his time. His greatest work is an ecclesiastical history of England, which was translated into Anglo-Saxon at the command of King Alfred. He died at Jarrow, May 27, 735.

**BEDFORD**, **JOHN PLANTAGENET** (1389-1435), Duke of Bedford and third son of HENRY IV, king of England, was born in England on June 20, 1389. His brother, HENRY V, created him Duke

of Bedford in 1414, the Duke acting as agent for HENRY V in England during his absence in France. After the death of his brother in 1422, the Duke took full control of the situation in France, and undertook to defend the interests of England through an alliance with Philip of Burgundy. Notwithstanding this alliance, the English suffered one reverse after another. Bedford was much censured because during this period he made no attempt to prevent the execution of Joan of Arc by the French at Rouen in 1431. He died at Rouen, France, on Sept. 14, 1435.

**BEDFORD**, the county town of Bedfordshire, England, situated in the rich Ouse River valley, 50 mi. northwest of London. Originally Saxon, it was later occupied by both Danes and Normans. Although the buildings and churches are largely rebuilt, they well represent Norman, Decorated and Perpendicular features. The 11th century castle to-day is little more than a mound, and there are only scant remains of a later Franciscan abbey. Bedford is famed chiefly for its association with Bunyan, and the congregational church, the Old Meeting, with its bronze doors commemorating *Pilgrim's Progress*, stands on the site of a building where he often preached. The town was once a lace-trade center, but to-day traffics in agricultural produce and implements and has large engineering works. Pop. 1921, 40,242; 1931, 40,573.

**BEDFORD**, a city and the seat of Lawrence Co., Ind., situated on the White River, about half way between Indianapolis, Ind., and Louisville, Ky. It has railroad and motor bus facilities and an airport. The agricultural output of the vicinity includes fruit, corn and wheat. Its chief natural resource, to which Bedford owes its industrial importance, is limestone of a high quality, used extensively as building material. The retail trade in 1929 amounted to \$7,735,799. Points of scenic and other interest near Bedford are caves, rock formations and mineral springs. The city was founded in 1825 and incorporated in 1864. Pop. 1920, 9,076; 1930, 13,208.

**BEDFORD**, a city in Cuyahoga Co., northeastern Ohio, situated 12 mi. southeast of Cleveland. It is served by two railroads. The city has chair, china, rubber products and aircraft factories, a machine shop and a foundry. First settled in 1786, Bedford was chartered as a village in 1852. Pop. 1920, 2,677; 1930, 6,814.

**BEDLAM**, in popular speech, the name for an old London lunatic asylum, the Hospital of St. Mary of Bethlehem. Originally established as a religious house in 1247, it was taken over by Henry VIII and made an insane asylum. The more normal inmates, who were allowed to wander about London streets, became known as "Bedlam beggars" or "Tom-o'-Bedlams." The asylum was twice pulled down, its present site being in the southeastern part of the city.

**BEDLOE'S ISLAND**, or Liberty Island, in New York Harbor, about one mile and a half southwest of the Battery on Manhattan Island. It is federal property. The island has had several names. First it was

known as Oyster Island. In 1670 it was referred to as Love Island. Governor Lovelace made it an exempted jurisdiction and about that time he was giving the exemption to Isaac Bedloe, and from this came the present designation. During the Revolutionary War it was known as Kennedy's Island. In 1841 it was known as Ft. Wood. The island, 13½ acres in extent, has the radio station which handles all the traffic for the military authorities of Governor's Island. Its most striking feature is the STATUE OF LIBERTY.

**BEDMOLD**, in architecture, the lowest molding or group of moldings in a classic cornice that together form the bracket supporting the corona, or the shelf-like projecting square portion. The purpose of the bedmold is as much aesthetic as structural. It helps to lighten and give interest to the shadow under the corona, and at the same time acts as a decorative band that separates the wall from the cornice.

**BED-SORE**, an ulceration of the skin, occurring in persons confined to bed for a long period of time. It is due to constant pressure of the skin upon the bed or irritation from urine or feces. The skin becomes reddened and edematous and there is often pain. If not checked, blisters are formed and finally ulceration. The most common site is over the end of the spine.

To prevent bed-sores the body should be washed frequently with soap and water and the part tending to irritation should be cleansed with antiseptic solution and dusted with oxide of zinc powder. Pressure should be relieved by a soft pillow or pneumatic cushion and the patient's position in bed changed as often as possible.

**BEE**, a member of a group of insects of the order *Hymenoptera*, distinguished from the Wasps by the possession of certain adaptive characters which enable them to collect honey and pollen. These characters are feathered hairs, which entangle and hold the pollen grains; elongate mouth-parts, for sucking nectar from tubular flowers; and dense brushes of hair beneath the abdomen, or on the hind legs, or specialized apparatus (corbicula) on the hind legs for collecting pollen. In very primitive

bees these characteristics are not distinctly developed, and it is very difficult in such cases, as well as in parasitic bees which have lost these adaptive characteristics by degeneration, to point out any structural distinction from wasps. Bees have evolved from the sphecoid wasps. Many thousands of species are known from all parts of the earth, but they



UNUSUAL HONEY BEE NEST

A colony ran wild, and, finding no cavity nor hollow in which to build, chose the branches of a tree



are much more abundant and diverse in tropical, semi-tropical and desert regions.

The habits of bees differ from those of sphecoid wasps, in that they feed their larvae with bee-bread, a mixture of pollen and honey, storing it with an egg in a cell of their nest. Most bees are solitary, each female constructing and provisioning her own nest. Many are gregarious, assembling their nests in villages. In the African genus *Allodape* (see SOCIAL INSECTS) there is transition from a solitary state to a primitive social community. A primitive social organization also occurs in the common sweat-bees of the genus *Halictus*. Highly organized gynarchic colonies with a worker caste occur only in the honey-bees (*Apidae*), the humble-bee (*Bombidae*), and the stingless honey-bees of the tropics (*Meliponidae*).

J. C. B.

**BEEBE, CHARLES WILLIAM** (1877- ), American naturalist, was born in Brooklyn, N.Y., July 29, 1877. He took a B.S. degree at Columbia in 1898 and after 1899 became curator of ornithology and director of tropical research of the New York Zoological Society for which he made a representative collection of living birds. His explorations in British Guiana, the Himalayas, Borneo, the Bermudas, Haiti and the Sargasso Sea have brought him distinction as a scientist; and his books, *Jungle Days*; *Galapagos*, *World's End*; *The Arcturus Adventure* and *Beneath Tropic Seas*, written in an engaging style, have made him a popular author.

**BEECH**, a genus (*Fagus*) of important timber trees of the beech family closely allied to the oak and chestnut. There are eight species, all natives of the Northern Hemisphere, one of which occurs in eastern North America. They are large trees with smooth, pale bark; close-grained, hard wood; thick, firm leaves; male (staminate) flowers in globular heads on drooping stalks and female (pistillate) flowers in small axillary clusters, and a prickly, bur-like, four-valved fruit enclosing one or two sharply three-angled nuts with a sweet, oily, edible seed.

The American beech (*F. grandifolia*) grows in rich bottom lands and on mountain slopes from Nova Scotia to Minnesota and southward to Florida and Texas. It is one of the most characteristic and beautiful of American trees, forming with birch and maple an important part of deciduous forests in the northeastern states and adjacent Canada. The tree, usually 70 to 80 ft. high, sometimes grows to a height of 120 ft. with a straight columnar trunk 3 or 4 ft. in diameter. When growing in the open it develops a rounded head with numerous slender, often drooping branches. In winter the very smooth, steel-gray bark gives the tree a striking appearance. The large, sharply toothed leaves, sometimes 5 in. long, turn bright yellow in autumn. Beech wood is used for making furniture, wooden ware, tool handles and shoe lasts. In 1930 the total cut of beech lumber in the United States amounted to 138,310,000 bd. ft. valued at the mill at \$3,580,845.90.

The similar European beech (*F. sylvatica*), with

much smaller leaves, is a valuable forest tree yielding useful timber. The nuts, commonly called mast, are used for fattening swine and yield a useful oil. Many highly ornamental foliage varieties are in cultivation, as the purple beech, the copper beech and the fern-leaved beech.

A. B. J.

**BEECHAM, SIR THOMAS** (1879- ), British orchestral conductor, was born at Liverpool, Jan. 20, 1879. He conducted an opera company in London and in 1908 founded Beecham's Symphony, later presenting a season of opera in Covent Garden. In 1915 he conducted the London Philharmonic Society. He introduced to England Richard Strauss' *Feuersnot*, *Salome*, *Elektra* and *Rosenkavalier*. Beecham was knighted in 1916. He produced about 120 operas and ballets. In 1928 and 1932 he visited the United States as a symphony conductor.

**BEECH-DROPS** (*Epifagus virginiana*), called also cancer-root, a peculiar leafless plant of the broom-rape family parasitic on the roots of the beech in the eastern United States and Canada. Its slender, much-branched purplish or yellowish brown stems bear minute scattered scales, and numerous small clusters of flowers, the upper ones whitish-purple and sterile, the lower ones inconspicuous and seed bearing.

**BEECHER, HENRY WARD** (1813-87), American clergyman, lecturer, reformer and author, was born at Litchfield, Conn., June 24, 1813. He was graduated from Amherst College in 1834, studied theology, became a Presbyterian clergyman and in 1847 was chosen pastor of the Plymouth Congregational Church in Brooklyn, N.Y. His congregation became one of the largest in the United States. His eloquence was remarkable for its dramatic power, pathos and wit. He was founder of *The Independent* and of *The Christian Union*. His sermons were published in numerous volumes entitled *Plymouth Pulpit*. In 1884 Beecher was tried for adultery on charges brought by Theodore Tilton. The jury disagreed, nine of the twelve favoring Beecher. He died at Brooklyn, N.Y., March 8, 1887.

**BEECHER, LYMAN** (1775-1863), American clergyman and theologian, was born at New Haven, Conn., Oct. 12, 1775. He was graduated from Yale in 1797. He was noted as a temperance and anti-slavery reformer. Beecher attained fame by a sermon against duelling, at the death of Alexander Hamilton. He wrote *Views on Theology*, *Six Sermons on Temperance*, and other works. He died at Brooklyn, N.Y., Jan. 10, 1863.

**BEE-EATER**, one of an Old World family (*Meropidae*) of brightly colored insectivorous birds, numbering about 30 species. They belong mainly to Africa, but extend also to southern Europe, India and Australia. They are related to the kingfishers and to the motmots of Central and South America, and are richly colored with glossy blues and greens. The European bee-eater (*Merops apiaster*) is about 11 in. in length and has an orange-yellow throat, blue wings and underparts and rich chestnut back. The two central feathers of the tail are long and



pointed; the bill is long, slightly curved and pointed. Bee-eaters nest in colonies in sand banks like bank swallows; on the wing, hawking after insects, they resemble large, brilliant swallows. They are also given to robbing beehives. The European bee-eater visits England at irregular intervals. C. J.

**BEEF**, meat obtained from cattle at least a year old. The food value of beef lies in its protein and fat constituents and the presence of mineral salts and vitamins. Beef is used most commonly in its fresh condition; corned beef is meat that has been cured by salting. Dried beef has had much of its water content removed and will keep almost indefinitely.

The better cuts of beef are used for steaks. Short steak, flank steak, rump steak, sirloin and tenderloin steaks come from the loin. Round steak comes from the round cut, the upper portion of the rear legs. Roasts are commonly taken from the ribs, the best quality being from the meat nearest the loin. Other cuts are used for soup, canned beef and corned beef.

In 1930, beef was the leading meat produced in the United States, the total fresh beef production exceeding 600,000,000 pounds. See MEAT TRADE.

**BEEF, CANNED**, beef that has been preserved by cooking, followed by prompt packing and sealing, hermetically, in cans. The canning of beef and other meats is a more certain method of preservation than either drying, curing, or refrigeration. Cooking provides complete sterilization of the meat and canning protects it from spoilage for an indefinite period. Canned meat is especially valuable to travelers and military forces that do not have access to fresh meat supplies. Large quantities of canned meat are used also by persons living in isolated places.

Although various parts of animal carcasses are canned, beef trimmings are the product used chiefly for this purpose. Except for a limited amount of home canning, the process is confined almost entirely to packing houses which have a sufficiently large volume of business to make the operation of a canning department economical. Roast, corned, and boiled beef and corned beef hash are among the more common canned beef products.

Rigid inspection of the cans to detect all that are not perfectly sealed is an important part of the operation, since the slightest leak is sufficient to cause spoilage of the contents. The cans used are of a wide range of sizes to meet the needs and convenience of all classes of customers. See also PACKING PLANTS.

J. R. M.

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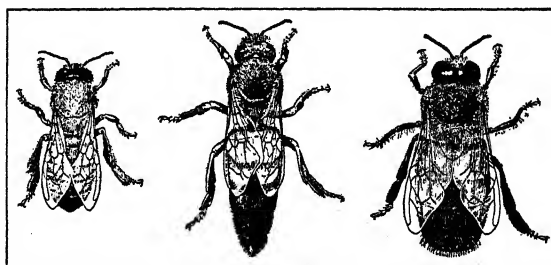
**BEEF EXTRACT**, a viscous fluid or paste obtained by extracting fresh meat with boiling water and concentrating the liquid by evaporation after removal of the fat. Its chief constituents are a small amount of coagulable proteins, proteoses, meat extractives (creatin and purin bases), and minerals, mainly potassium phosphate. The nutritive value is very small, but it is appetizing and stimulates gastric secretion.

**BEE-FLIES**, insects of the large family *Bombyliidae*. Some species resemble certain bees, but are two-winged and stingless. Others somewhat resemble horse-flies. Adults are active insects which visit flowers to feed on nectar and pollen, and are often seen hovering over bare ground in spring. The larvae of many species are parasitic on certain other insects. Bees, wasps, beetle larvae, the larvae and pupae of cutworms and the eggs of several species of grasshoppers, may serve as hosts.

**BEEFWOOD** (*Casuarina equisetifolia*), a valuable ornamental and timber tree of the casuarina family called also she-oak. It is a native of Australia extensively planted in semitropical countries, including Florida and southern California, and widely naturalized in warm regions. Beefwood is a narrow, very tall tree, sometimes 150 ft. high, with scanty, rush-like foliage on drooping branches swaying widely in the wind. The red, very hard, valuable wood somewhat resembles that of the oak. The tree is planted in the extreme south for its remarkable appearance, rapid growth, adaptability to saline soils and its ability to hold sands along seacoasts. See also CASUARINA.

**BEEKEEPING** or **APICULTURE**. The honey-bee, presumed to be a native of Asia, was already domesticated in Syria, Egypt, Palestine and Greece when history began, and is now found throughout the world.

One result of domestication is the development of distinct races of which the principal ones are Cyprian, handsome, yellow, but not popular because extremely excitable; Carolinian or Gray, gentlest of all, but so ready to swarm that it is not generally profitable; Caucasian, not fully tested since its introduction in



COURTESY U. S. BUREAU OF ENTOMOLOGY

Worker

Queen

Drone

HONEYBEES

America; German or Black, though irritable, highly popular in America, because of the hardy, excellent workers and makers of whitest of all combs; Italian, handsome, yellow banded, most satisfactory and profitable because prolific, energetic workers, gentler but tenderer than German and Cyprian and must be protected in cold climates to winter well.

Primitive beekeeping methods, which still persist throughout the world and even to some extent in America, necessitate the destruction of the bees when honey is required. America must be credited, however, with the greatest advance of all time in beekeeping, through the invention in 1852 by the Rev.

L. L. Langstroth of a hive which permits the removal of honey without destroying the bees. This invention is chiefly instrumental in having changed beekeeping from a hobby into a highly profitable and fascinating branch of agriculture. Langstroth's invention has been improved and supplemented by the inventions of A. I. Root, who deserves a large share of the credit for establishing the world's standard of agricultural methods and equipment and the United States and Canada as the leading producers of honey and beeswax. Whereas in other countries beekeeping is conducted mainly by peasants whose methods produce merely hundreds of pounds, in America it attracts highly intelligent men and women who produce honey by the ton, individual yields of 50,000 to 60,000 lbs. a year being common, and market it by business methods that yield large profits. Comparison of honey is in favor of the American product mainly because the hives permit keeping the honey of each principal flower separate.

Although bees are said to travel miles for honey, best results are secured when apiaries are located where blooming plants are abundant. To insure bee forage apiaries are often transferred from place to place when one supply gives out and another starts. The honey gathered in early spring from wild flowers is all needed by the bees themselves. In great orchard areas sometimes a little surplus honey is gathered from fruit tree bloom but usually the important commercial sources of honey are such trees as locust and basswood and such crops as clover, alfalfa and buckwheat. During autumn goldenrod, native asters and other wild plants are relied upon to provide stores for the winter. In cold parts of

the country colonies with less than 20 lbs. of honey are artificially fed to insure their passing the winter safely. M. G. K.

**BEELZEBUB**, the Greco-Latin spelling of the Hebrew and Syriac *Baal-Zebub* or *Baal-Zebul*, meaning Lord of Flies, a god of the PHILISTINES at Ekron. It was this deity (I Kings 1) that Ahaziah, King of Israel, when he fell from a lattice window, inquired whether he would recover. In the Gospels Beelzebub (Matthew 12:24) appears as "the Prince of the Devils." A charge against

Jesus was that he cast out devils by means of Beelzebub. In *Paradise Lost* Milton graphically describes Beelzebub as ranking second only to Satan "in power, and next in crime."



COURTESY IOWA GEOL. SURV.  
ROCKY MOUNTAIN BEE PLANT

**BEE PLANT, ROCKY MOUNTAIN** (*Cleome serrulata*), a handsome annual of the CAPER family,

native to prairies of the western states and Canada and cultivated for honey production. It grows about 3 ft. high, bearing leaves of three leaflets and very showy clusters of rose-colored or white flowers, followed by narrow seed pods.

**BEER, THOMAS** (1889- ), American writer, was born at Council Bluffs, Iowa, Nov. 22, 1889. He was graduated at Yale, then studied law at Columbia. In 1917-1918 he served with the field artillery in France. Besides writing many stories for the magazines, Beer is the author of *Fair Rewards*, *Stephen Crane*, *Sandoval* and *The Mauve Decade*.

**BEER**, a beverage made by the alcoholic fermentation by yeasts of malted barley and hops, with or without other unmalted grains. There are many kinds of beer, differing in their content of alcohol and extractives (carbohydrates, proteins and flavor from hops) with the amount and kind of fermentation. In the Lager type of beers, the malt is mashed with warm water and heated slowly. The yeast (*see* YEASTS) settles to the bottom of the vessel as fermentation proceeds. Varieties are named for towns in which they became famous, such as Pilsner or Bohemian beer, Münschner or Bavarian beer. The English type of beers is fermented with a variety of yeast which rises to the top of the vessel after fermentation. This type includes both mild and bitter beers. Beer contains about 2.5 to 5% alcohol by weight.

**BEERBOHM, MAX** (1872- ), English author and caricaturist, was born in London, Aug. 24, 1872. His mother was an American. Beerbohm took up the pen before his graduation from Oxford. He is the author of *More, Yet Again, And Even Now*, *A Christmas Garland*, *The Happy Hypocrite*, *Seven Men*, *The Poet's Corner*, *A Book of Caricatures*, *The Second Childhood of John Bull*, *Ships, New and Old* and *Observations*.

**BEE-STINGS.** *See* INSECT BITES AND STINGS.

**BEESWAX**, a plastic substance secreted by worker-bees and used by them in making honeycomb cell walls. Beeswax has a yellowish-brown color and an odor resembling that of honey. It is soluble in chloroform and carbon tetrachloride, but not soluble in water. It melts at 62 to 64° C. and after proper treatment it becomes white, tasteless and reasonably brittle. Beeswax is used commercially for the manufacture of church candles, polishes, modelling wax, ointments, sealing wax, lithographic crayons and the like. To obtain it the honeycomb is melted in hot water, strained and pressed.

**BEET** (*Beta*), a genus of biennial plants of the goosefoot family, related to SPINACH, LAMB'S QUARTERS and ORACH. Several species are grown as annuals for ornament or for food. The most important varieties, cultivated since before the Christian Era, are thought to be developments of a perennial species (*Beta vulgaris*), native to European coasts. They are grouped as garden beet, sugar beet, mangel wurzel, chard or spinach beet and foliage beet, the last named grown for its decorative foliage. Garden beets vary greatly in form, from flat, thick, disc-like and globular to long

and tapering; in color they range from dark red to almost white, and in length of maturing in season from 3 to 7 or 8 months. Summer varieties may be kept a few weeks only but winter beets keep several months.

#### BEETS, COMMERCIAL PRODUCTION, U.S.,

4-Year Average, 1927-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES .....	9,768	1,661,000	100.0
LEADING STATES:			
New Jersey .....	1,575	380,000	22.9
Louisiana .....	3,795	259,000	15.6
Nor. Carolina .....	493	197,000	11.9
Mississippi .....	420	87,000	5.2

Beets thrive best in cool climates and seasons. All varieties are hardy and may be sown in earliest spring, the early maturing kinds successionaly until midsummer or even later. The late ones are more tender than the same varieties sown in spring and allowed to grow until autumn. They are comparable to the long varieties, which are regarded as the acme of quality. Deep, rich, friable soil and good cultivation produce the finest beets. The seeds, or rather dried fruits which usually contain from one to several seeds, must be sown thinly because they usually develop several plants each. When 2 or 3 in. tall the crowded plants must be thinned to stand at least 3 in. apart and the excess plants transplanted, if desired. They transplant easily in most soil. M. G. K.

**BEETHOVEN, LUDWIG VAN** (1770-1827), German music composer, was born at Bonn, probably on Dec. 16, 1770. His father, Johann, was a singer, and his mother, Maria Magdalena Leym (*née Keverich*), was a daughter of the chief cook at Ehrenbreitstein. At the age of four he began studying the violin and clavichord, played in public at the age of eight, and then obtained additional instruction from Pfeiffer and the organists Van den Eeden and Neefe. For a time he was assistant organist at the electoral court in Bonn, also playing the viola in the Bonn opera-house, publishing a few compositions. At the age of twenty-two he studied for a brief period with Haydn, later with Schenck and Albrechtsberger. His instruction, however, was irregular. Irregular also in habits, haughty in manner, and slovenly in personal appearance, he nevertheless was extraordinarily industrious when the creative urge was upon him. He obtained the patronage of Count Ferdinand Waldstein and Prince Karl Lichnowsky, who saw great promise in his work. Owing to a disease which he contracted in youth, his hearing was early affected, and advancing deafness increased his irascibility. This affliction, together with several unhappy love affairs and the ingratitude of his nephew Carl (the son of his brother, Caspar Beethoven), deepened the natural melancholy of his nature; more and more he became moody and introspective. But while his contempt for people grew greater, his compositions won increasing admiration. In 1815 he was given the freedom of the

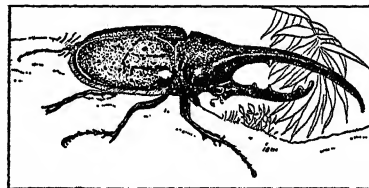
city of Vienna, where Beethoven died March 26, 1827.

Sometimes known as the "Shakespeare of music," in testimony of his comprehensive and tempestuously poetic utterance, Beethoven is commonly ranked a little lower than Bach as a pure musician, but above that master as a tonal dramatist. To HAYDN and MOZART, especially to the former, he was heavily indebted for the development of the SONATA; into that crystallized form he poured a flood of emotion which transformed a classical mould by informing it with romance and passion. His chief works are: 9 symphonies, 9 overtures, 5 pianoforte concertos, 38 pianoforte sonatas and a score of sets of variations for that instrument, a violin concerto, 10 violin sonatas, 3 string quintets and much additional chamber music, an oratorio, and an opera *Fidelio*.

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**BETLE.** See PLASTICS; RESINS, SYNTHETIC.

**BEETLES**, members of the very large order *Coleoptera*. Larvæ are commonly called grubs. They are soft-bodied creatures with chewing mouthparts, well-known to everyone. Metamorphosis is complete. Rude cocoons composed of bits of wood or earth fastened together by a viscid excretion are usually made, within which the pupal stage is passed. Adults, if winged, have two pairs of wings. The



HERCULES BEETLE

first pair are greatly thickened and known as elytra. Beneath these covers the thin membranous second pair are folded when not in use. By these wing characters, beetles are separated from all other insects except the earwigs. In a few species of beetles, the hind wings are lacking. In still others, adults are completely wingless. Mouthparts are fitted for chewing. J. R. T.

**BEET LIFTERS**, machines for harvesting beets. The type of beet lifter commonly used resembles a single-row riding cultivator, but the frame is stronger and is equipped with two lifting blades or shoes. These blades are set to raise the beets about four inches, thus breaking the roots.

**BEETS, NIKOLAAS** (1814-1903), Dutch writer, was born at Haarlem, Sept. 13, 1814. He studied theology at Leyden but devoted his time to writing until 1854, when he was appointed to a pastorate at Utrecht. His early poems show an influence of BYRON which is not noted in his great work, *Camera Obscura*, an imaginative prose composition of humorous but sympathetic studies of peasant life. Beets died Mar. 12, 1903.

**BEET SUGAR.** See SUGAR; CARBOHYDRATES.

**BEGGAR'S OPERA, THE**, a lyrical drama by the English poet, JOHN GAY, with music by Dr. Pepusch. It was first produced in 1728. Tuneful and sparkling, this little opera, which Swift is said to have suggested, is a satire on the governing class of 18th century England, a rollicking opera of thieves and highwaymen, led by Captain Macheath and his fair wife, Polly Peachum. Revivals of the work have been very popular both here and in England.

**BEGGAR-TICKS**, a name given to various species of BUR MARIGOLD (*Bidens*) with thin flattened seeds (achenes) bearing backwardly barbed awns which readily adhere to the skin of grazing animals, thus aiding in their dissemination.

**BEGONIA**, a genus of succulent herbs and subshrubs named in honor of the French botanist Michel Begon (1638-1710). There are 400 or 500 species, all natives of warm countries. Some species have fibrous roots, others tuberous, still others semi-bulbous. The flowers, the colors of which range from purest white to rich red and to lemon yellow, vary from a quarter-inch in some of the shrubby species to more than six inches among the tuberous kinds. The former are showy because of their abundance, the latter because of their size. Others, especially the rex varieties, have curiously marked, large and conspicuous leaves. Because of these characteristics and the ease of their culture, begonias constitute one of the most popular groups of ornamental plants. Although most species and varieties are grown in hot houses and window gardens some are excellent for outdoor culture as bedding plants. They are tender to frost, however, and their season of outdoor usefulness extends between late spring and early autumn.

**BEGUINES**, women dwelling in medieval communities, called Beguinages, usually established in the vicinities of towns so that their members could minister to the sick and poor. Though never constituting a religious order, they exerted a powerful influence in the Netherlands, Germany, France and Italy for more than two centuries. Suppressed by the Council of Vienne, 1312, they were restored by John XXII in 1321; but the Reformation and the French Revolution swept away all but a few of their establishments, still to be found in Belgium and Holland. A similar institution for men, called Beghards, flourished among the Flemish craftsmen, but, becoming associated with heretical sects, were condemned and declined as the cloth industry waned; their dissolution was completed by the French Revolution.

**BEHAVIORISM**, a movement in psychology confining itself to objective methods and adopting the mechanistic approach. It would regard the subject matter of psychology as limited to terms of behavior. Consciousness, if it exists at all, is not a legitimate field for the psychologist to concern himself about. His interest is rather that of studying the manifestations of behavior. The key to such a procedure is the stimulus-response relationship. The behaviorist can note what takes place at both ends of this circuit, but

he knows nothing about what goes on in the individual's consciousness; in fact he is not interested in psychical states and has an antipathy for the word consciousness.

The conditioned reflex is central to the development of the behavioristic position. This is the basis of habit and habit is largely a matter of how the individual has been conditioned. The older conception of instinct has undergone considerable modification in connection with this view. From a few action tendencies, which are by no means the fixed sort of thing that an instinct is, almost any habit may be built up by the proper conditioning methods. The terms sensation, image and idea are foreign to the language of behaviorism. Even thinking, from Watson's point of view, is nothing but a language habit.

The behavioristic movement is less than twenty years old. It is an outgrowth of comparative psychology, the same methods that had been used in animal learning having been applied with much success to human learning. Nevertheless the mechanistic approach of behaviorism does not seem to account for all phases of learning. There are those who hold that meaning and understanding, situations involving purposive behavior, and the function of intelligence in guiding conduct are not adequately accounted for by its premises. The tendency seems to be to accept a modification of behaviorism in a more pragmatic psychology.

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**BEHEADING.** See CAPITAL PUNISHMENT.

**BEHISTUN ROCK**, a bas-relief and inscription found on the ancient road between the Persian cities of Babylon and Ecbatana. It tells in detail how Darius I, King of the Persians in the 6th century B.C., crushed a revolt against his throne and offered the captive rebels as a sacrifice to Ahuramazda. The relief pictures the story of the inscription, and gives interesting detail of the variety of costume and characteristics to be found in that vast empire. It is extremely well preserved. The inscription is written in Babylonian, the language of Elam, and Old Persian, all three of them cuneiform scripts. This was the means of deciphering cuneiform writing; for although the rock was known to antiquity, it was during the years 1835-45 that an Englishman, Rawlinson, first succeeded in reading the text, and thereby became the founder of the science of Assyriology.

**BEHN, APHRA** or **AFRA** (1640-89), English novelist and dramatist, was born at Wye, Kent, in 1640. Her childhood was spent in Surinam or Dutch Guiana. Celebrated for her wit, Aphra Behn was present at the court of Charles II, and for a time served that monarch as a spy in Antwerp. Her many novels, plays, poems and letters are notable for their Restoration cleverness and their indelicacy. Among her dramatic works are *The Forc'd Marriage*, *The Amorous Prince*, *The Dutch Lover* and *The Debauchée*. Her best known prose work is *Oroonoko*. Aphra Behn died in London, Apr. 16, 1689.

**BEHRENS, PETER** (1868- ), German architect and painter, was born at Hamburg, Apr. 14, 1868. He studied under Prütt at Düsseldorf and under Kotschenreiter in Munich and spent some of his youthful years as a painter in south Germany. He later interested himself in art education, and in 1922 became professor of art at the Vienna Academy. Behrens was one of the earliest architects to devote himself seriously to the problems of modern industrial and office buildings and has had a marked influence on the development of their modern stark and geometrical style. Perhaps his most famous work is the German embassy in Leningrad built in 1901.

**BEHRING, EMIL ADOLF VON** (1854-1917), German bacteriologist and physician, was born at Berlin, March 15, 1854. In 1890, by animal experimentation, with Kitasato, he produced immunity against tetanus by use of serum from an infected animal; and later, by a similar method von Behring produced immunity against diphtheria by use of diphtheria antitoxin, which has since become universal. Von Behring died at Marburg, Germany, Mar. 31, 1917.

**BEIRUT**, a city of Syria, situated about 90 mi. northwest of Damascus, with which it is connected by rail. It is the principal seaport of the country and capital of Great Lebanon, an autonomous state. The French high commissioner for Syria lives in Beirut. It has a large number of mosques and about 40 Christian churches of many kinds. Foreign missionaries conduct various schools in Beirut. The streets of the town, although narrow, are clean and well paved and dotted with drinking fountains, copiously supplied with water by an aqueduct.

Commercially, Beirut is the most important city of Syria. It is the center of the book-trade of the country and manufactures silk stuffs, gold and silver thread, carpets, tapestries and filigree work. Silk, wool, gum, fruits, hides and live stock are the exports, and salt, rice and flour are imported.

The city was called Berytus in the classical period and was famous in Roman times for its excellent law school. The Arabs conquered Beirut in the 7th century. Baudoin I, King of Jerusalem, took it in 1110. Recaptured by Saladin in 1187, Beirut soon afterward fell into the hands of the Druses. Pop. 1929, 134,655.

**BEISA** (*Oryx beisa*), a large antelope native to eastern and northeastern Africa, found chiefly in the region from Suakin on the Red Sea, southward through Somaliland to Kilimanjaro. About the size of a small zebra, the beisa is distinguished by its long, almost straight horns which are present in both sexes. It has a long tail with a dark terminal brush and the face is conspicuously banded in black and white. These animals are desert dwellers, living on stunted bush and the coarse grass that grows in the desert after rain. The beisa is the true oryx of the ancients and may have suggested the unicorn legend.

**BÉKÉSCSABA**, a Hungarian city in the county of Békés, situated in the midst of a fruitful region, surrounded by protective dikes. The city has five churches and several fine buildings. Industrially

active, it has large mills and produces sausage, silk, woven goods, and earthenware. Pop. 1930, 49,295.

**BEKKER, ELIZABETH** (1738-1804), Dutch poet and novelist, was born at Vlissingen, Holland, July 24, 1738. She became the wife of Adrian Wolff. As Elizabeth Bekker she wrote, with Agatha Deken, *Sara Burgerhart*, also *William Levend* and *Cornelia Wildschut*. She died at The Hague, Nov. 4, 1804.

**BELALCAZAR, SEBASTIAN DE** (1495-1551), Spanish conquistador and soldier. He came to America with Columbus on his third voyage and participated in various expeditions into Central America. When Pizarro was conquering Peru, Belalcazar accompanied him and was stationed with a reserve force in the north. On his own responsibility he subdued the region of modern Ecuador, and became governor of Quito. Stories of El Dorado lured him northward from Quito and he spent the years between 1535 and 1538 exploring the western portion of Colombia, establishing the settlements of Cali and Popayan. Pressing north to the Caribbean he came upon the plateau of Cundinamarca, where he found that Gonzalo Jiménez de Quesada had already established Bogota. He sailed to Spain in the same ship with Jiménez de Quesada, and was recognized by the Crown as Adelentado of the province of Popayan. Returning to Popayan, he became involved in a long dispute over possession of the region of Antioquia with a former lieutenant, Jorge Robledo, whom he eventually executed. Brought to trial by the Crown, he died on the way to Spain, and was buried at Cartagena.

**BEL AND THE DRAGON**, a fragment in the apocrypha, additional to the Biblical narrative of Daniel. Bel was an idol in a temple, and behind locked doors consumed food. By scattering ashes on the floor, which revealed footprints, Daniel exposed the secret doors by which the food had been taken away in the night, so discrediting the idolatrous priests. The dragon or serpent was alive; and in its case divine pretensions were exploded by a meal of "pitch and fat and hair" which Daniel put in the dragon's mouth, causing it to "burst in sunder." The stories are vividly told and illustrate the struggle between the monotheism of the Hebrew exiles and the Babylonian heathendom around them. See BAALIM.

**BELASCO, DAVID** (1859-1931), American playwright and theatrical producer, was born at San Francisco, Calif., July 25, 1859. He was graduated from Lincoln College, Calif., in 1875. He began his career as stage manager of theaters in San Francisco and New York City, and later became the operator of theaters in several American cities. His success in training actors and his remarkable ability in stage lighting and setting gained him a preeminent name as an American producer. In addition, Belasco was the author of or collaborator in 200 plays. He presented E. H. SOTHERN in *Lord Chumley*, 1888, Mrs. LESLIE CARTER in an adaptation of *Zaza*, 1899, and *The Heart of Maryland*, 1895, Blanche Bates in *Naughty Anthony*, 1900, and DAVID WARFIELD in *The Music Master*, 1904, and *The Merchant of Venice*,



1922. Among his own plays are *May Blossom*, 1882, *Du Barry*, 1901, *The Girl of the Golden West*, 1905, *The Return of Peter Grimm*, 1911, *Kiki*, an adaptation, in 1921, and *The Darling of the Gods*, in which he collaborated with John Luther Long. For elaborateness and realism in scenic effects Belasco was not excelled by his American contemporaries. He died at New York, May 14, 1931.

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**BELDING**, a city in Ionia Co., southwestern Michigan. It is situated on the Flat River, 30 mi. northeast of Grand Rapids on the Pere Marquette Railroad. Belding is an important silk-manufacturing center; it was founded in 1838. Pop. 1920, 3,911; 1930, 4,140.

**BELÉM, or PARÁ**, a port of Brazil, capital of the state of Pará, is situated on the east bank of the River Pará, 80 mi. from the Atlantic. Outside of Brazil this city is referred to as Pará. Belém has attractive plazas, a unique forest park, a museum, a white marble theater, the convent of San Merced and the president's palace, all worthy of notice. The streets are mostly broad, well-paved and kept decently clean. Several of the thoroughfares are lined with fine palm trees. The mean temperature is 78° F. The harbor works, completed in recent years and costing over \$60,000,000, have been of immense value. They include a quay 1½ mi. in length, along part of which the water is 30 ft. deep; and docks and oil storage tanks. A channel from the outer river, 30 ft. deep, is marked by 26 illuminated buoys.

The city was founded in 1615 but was little heard of until the end of the 19th century when, after being nearly ruined by civil strife and epidemics, it rose to prominence during the rubber boom, acquiring at the time a considerable wealth which it spent for fine edifices and handsome boulevards. In 1910, when the amount of plantation rubber from the Far East placed on the market was sufficient to cause a break in the high prices, the crisis resulted in the ruin of most of the rubber firms in Belém and also of many producers carrying extended credits. The growth of her shipping causes Belém to remain the principal commercial city of northern Brazil. Pop. 1920, 236,402; est. pop. 1930, 279,491.

**BELFAST**, the capital of NORTHERN IRELAND and the chief commercial and manufacturing city of Ireland. It stands at the head of Belfast Lough on the River Lagan, at the base of a lofty chain of hills that ends with Cave Hill, 1,188 ft. high. It is 112 mi. north of Dublin, 12 mi. from the Irish Sea and 156 mi. northwest of Liverpool.

Belfast is a comparatively modern town, the first charter having been granted by James I in 1613. From an early date the making of linen became an important industry. The great shipbuilding works, which are equally famous, are a more modern enterprise. Other large manufactures include ropes, whisky, carbonated beverages, tobacco, artificial manures and felt. Belfast has a clean and pleasant appearance for a

manufacturing city. The finest public building is the City Hall, a dignified edifice in the center of the town. Other noteworthy structures are Queen's University and the new Museum and Art Gallery in the Botanic Gardens. The government buildings, completed in 1931, are situated a few miles from the City Hall.

Belfast, which so long resisted the re-establishment of a Parliament for Ireland, obtained a Parliament for itself in 1921. Pop. 1926, 415,151.

**BELFORT**, a fortified town in northeastern France, capital of the territory of Belfort, situated in a strategic position between the Vosges and the Jura mountains, about 40 mi. west of Basle. Belfort is especially celebrated for its heroic resistance during the Franco-Prussian War of 1870 to German armies in a siege which lasted from Nov. 1870 to Feb. 1871. The French garrison, commanded by Col. Denfert-Rochereau, consisted of about 17,600 men, of whom about 5,000 were lost; of the 23,000 German troops, commanded by Gen. von Tresckow, approximately 2,000 were killed. Bartholdi's colossal monument, "Lion of Belfort," commemorates the siege. The town, which is divided into the fortified Old Town and the New Town, has thriving industries in both machinery and textiles. Belfort escaped invasion during the World War but was damaged by bombardment. Pop. 1931, 42,511.

**BELGAE, THE**, included those German and Celtic tribes which, at the time of Caesar's invasion of Gaul, 55 B.C., and for an indeterminate period before, inhabited the region between the Rhine River, the Seine and Marne basin, and the ocean. It appears likely that the pressure of invading tribes from the other side of the Rhine forced various emigrations of the Belgae to the shores of Britain, across the Channel. It is certain, from Caesar's testimony, that they were the most warlike and valorous tribe in Gaul and it seems probable that at that period the Belgae were largely German in customs, beliefs, and methods of fighting. Despite the profound mixture resulting from the Germanic invasions, the region originally occupied by the Belgae retained through the five centuries sufficient Celtic elements to withstand complete Germanization. To-day the linguistic line may be drawn between the French-speaking Walloon population of Belgium and the German-stemmed Flemish group.

See Caesar, *Gaulic War*; T. R. Holmes, *Caesar's Conquest of Gaul*, 1899.

**BELGIAN CONGO**, formerly Congo Free State, a Belgian colony in equatorial Africa, surrounded by French Congo on the northwest, Angola on the southwest, Rhodesia on the south and southeast, Tanganyika and Uganda on the east, and Sudan on the northeast. A shore coast line borders on the South Atlantic at the mouth of the CONGO RIVER. The area comprises about 918,000 sq. mi.; population 8,700,000. Several tribes, almost all Bantu in speech, inhabit the region and in some districts pigmy tribes are found.



The colony occupies the greater part of the basin of the Congo River, a saucer-shaped depression about 1,000 ft. above sea level, rising round the rim to heights of 6,000 ft., and higher in the east.

A greater part of the surface is dense forest, but about 13,000 acres are given over to raising rubber. Wild coffee trees abound. Cocoa cultivation has not been a great success, chiefly because of the irregular rainfall. Rice and sisal cultivation have developed rapidly and gum copal from the swamps provides a fairly important export. Elephants are still numerous in the Congo basin and shipments of ivory are made in considerable quantity. There has been a great development in oil-palm products, the kernels forming a larger export than palm oil, and recently some progress has been made in cotton production. The Ituri district near Lake Albert and the area around Lake Kivu, inhabited by a relatively dense and vigorous native population, are now to some extent settled by whites, who raise coffee and cattle.

Mining operations employ about 100,000 natives. The Katanga district, a portion of the plateau on the south, has become very important because of its rich mineral deposits. Copper is the chief metal and diamonds, tin, cobalt, zinc ores, iron, limestone and inferior coal are also mined. There are gold-bearing reefs northwest of Lake Albert. Transport difficulties hinder the exploitation of minerals.

The chief towns are Leopoldville, the administrative center; Matadi on the Congo; Elizabethville in Katanga; and Boma, Banana and Stanleyville. The Parc National Albert, a forest preserve in the Kivu district, has an area of about 3,300 sq. mi., and is occupied by elephants, buffaloes, antelopes, gorillas, etc.

The Congo Free State was formed in 1885 from a trading association founded by H. M. STANLEY and LEOPOLD II of Belgium. It was annexed to Belgium in 1908 and includes the Ruanda-Urundi district, 20,550 sq. mi. around Lake Kivu, mandated from old German East Africa. Education is in charge of missionaries, aided by the government, which is located at Brussels. A governor-general administers the colony. In 1928, there were more than 23,000 Europeans, of which 15,900 were Belgians.

**BELGIAN LITERATURE.** The literature of Belgium has been written in three distinct languages, Flemish or Dutch, French and Walloon, a dialect of Romance origin. Up to the revolution of 1830, when Belgium separated from Holland, Flemish and Dutch literature are identical (*see* DUTCH LITERATURE). But after this date French became the literary and official language of the newly-established kingdom and as a consequence the most important, but by no means all the literary production has been in that language.

Although French has been the language of the cultivated classes in Flanders and the Walloon provinces since as early as the 12th century, Belgian literature in French dates only from the establishment of the independent kingdom of Belgium in 1830. For a time the literary output of the Belgians in this lan-

guage was merely an imitation of French models, but in 1880 a movement, known as "Young Belgium" came into being, whose object it was to arouse a nationalistic spirit in Belgian writers. While French was to be retained as the language of production, the spirit of this production was to be Flemish or Walloon. The leading men in this movement were MAURICE MAETERLINCK, Georges Eekhoud, Camille Lemonnier, J.-K. Huysmans, and Georges Rodenbach. The first-named has achieved world-wide renown and so far remains the outstanding figure of Belgian literature. Beginning by contributions to a Paris newspaper he later turned to playwriting, his efforts in this field giving him an international reputation. His philosophical works, *The Treasure of the Humble* and *Wisdom and Destiny* have also won for him countless readers beyond the boundaries of his own country. The greatest poet that the movement produced was ÉMILE VERHAEREN, whose work was distinguished by much originality and audacity. During the World War Émile Cammaerts published a considerable number of poems which were much discussed abroad. Possibly, however, it is in the drama that modern Belgian writers have chiefly excelled. Setting aside the astonishing success of Maeterlinck's *Blue Bird*, *Pelleas and Melisande* and other plays, Verhaeren's *Helena of Sparta* was produced in Paris in 1912 with much acclaim, and in 1920 F. Crommelynck, with his *Le Cocu Magnifique*, obtained in the French capital a success that may be said to have duplicated Maeterlinck's.

Of recent years Belgian literature has been accorded patronage by the State. In 1920 the Belgian Academy was founded, which by prizes and other marks of distinction seeks to further the prestige of Belgian letters. The members of this body number 14 and its official language is French.

Following the declaration of French as the official language of the new kingdom of Belgium in the early part of the 19th century, a real renaissance of Flemish literature took place. Although Flemish and Dutch are from the literary aspect identical as a language, the spirit of this renaissance was strongly antagonistic to Holland and its people from whom the Belgians had so recently separated. The leading figure in this revival was HENDRIK CONSCIENCE, known as the Sir Walter Scott of Flanders. Born in Antwerp in 1812 of a French father and Flemish mother, he won international fame with his historical romances, the best known of which are *The Wonderful Year*, and *The Lion of Flanders*, while his *Rikke-Tikke-Tak* has been translated into all European languages. Other notable works from his pen are *Blind Rosa*, *The Decayed Gentlemen* and *The Miser*. His rise to fame and financial independence was more than ordinarily slow and arduous, for, having been turned out of his home by his French father for the sin of writing his first book, *The Wonderful Year* in Flemish instead of in French, he was for years obliged to earn his bread by any means that came to hand, and for some time was a working gardener. Nevertheless,

novels continued to flow from his pen and by the middle of the 19th century he was known to book lovers the world over. His prestige in his own country was immense notwithstanding the fact that he had flouted precedent in deliberately choosing to write his novels in Flemish. His success brought into the field a host of imitators, but none ever succeeded in even faintly approaching his standard. Conscience spent the years of his fame in Antwerp, and when he died in 1883 his renown was such that he was accorded a State funeral. The outstanding poet of the Flemish literary movement was a priest, Guido Gezelle (1830-99), whose work is distinguished by a fiery patriotism, a deep love of nature and strong religious feeling. The most popular Flemish novelist of the 20th century is Felix Zimmermans (1886- ).

The Walloon language is a French *patois* spoken in the provinces of Liège, Hainaut, Namur, Luxembourg and Brabant. The inhabitants of these provinces are Latins by origin, being the descendants of the Gallic Belgi, but in the course of time Teutonic additions have been combined with the Romance body of their language. As a literary language Walloon has been superseded by French, and little writing of any real importance was produced until the 19th century, when signs of a revival of interest in Walloon literature were perceptible. The chief figures in this revival was the poet, Nicolas Defrecheux (1825-74), who attracted much attention with his *Let Me Cry* and his *Walloon Songs*. Further stimulus to the movement was supplied in the 1870's by the formation of a considerable number of literary and dramatic clubs whose avowed purpose was to revive interest in Walloon literature. Nevertheless, the appeal of this branch of Belgian literature remains very limited, and Belgian writers desiring to strike the serious or tragic note invariably use the French language, leaving Walloon as the vehicle for light-hearted poems, comic farces and burlesques.

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**BELGIAN TREATY OF NEUTRALITY**, a celebrated pact signed at London on Apr. 19, 1839, by Austria, France, Great Britain, Prussia and Russia. Under its terms the five Governments guaranteed the sanctity of the Belgian frontiers, and pledged to intervene if the borders were violated by another nation. The status of Belgium territory was declared one of perpetual neutrality "in the name of the most Holy and Invisible Trinity." Despite the surface indications of its benevolence, the arrangement was first made by the great powers in 1830 as a check upon the ambitions of France after the July Revolution. Belgium was "held to observe the same neutrality toward all other states," and the only advantage to her in the instrument was the "right" to call on the signatories for military support if one or more crossed her frontiers. King Albert availed himself of this

clause on Aug. 2, 1914, appealing to King George of England to safeguard Belgian neutrality. On the same day the German Government offered to respect Belgian neutrality if Brussels permitted the transport of German troops over the frontiers. The next day Belgium declared her intention of repelling this "flagrant violation of international law," and on Aug. 4 the English House of Commons approved an ultimatum to Germany demanding observance of the Belgian Treaty of Neutrality. The Germans on their part claimed that by entering into secret military conversations in the years immediately before the WORLD WAR the English and Belgians had themselves violated the Neutrality Treaty.

**BELGIUM**, a kingdom of northwest Europe, bounded on the north and northeast by the Netherlands, on the east and southeast by Prussia and Luxembourg, on the south and west by France, and on the northwest by the North Sea, which separates it from England.

**Area and Population.** The area is about 11,755 sq. mi.; pop. 1930, 8,129,824.

Before the World War Luxembourg was independent, but it formed part of the Zollverein, or German Customs Union. To-day it is still independent, but has formed an agreement with Belgium covering customs, coinage and railways.

Belgium is densely populated, averaging 686 inhabitants per sq. mi. The provinces of Antwerp and Brabant average over 1,000. There are two racial stocks. About one-half are Flemish, closely allied to the Dutch. The other, the southern half, are the Walloons. Until March, 1932, Belgium had two official languages, French and Flemish. The new language bill passed then divided Belgium into three districts: Wallonia, where only French is the official language, Flanders, where Flemish is the official language, and Brussels, which is bilingual.

**Physical Features.** The 42 mi. seacoast is separated by a line of dunes from the low plain of the interior. The land rises gradually towards the southeast, but to the north the surface is flat throughout the greater part of three provinces. In the center of the country nearly parallel undulations of the ground separate the tributaries of the Scheldt; and the surface rises to an elevation of about 600 ft. along the banks of the Sambre and Meuse. Southeast of the line formed by these rivers the land rises to the forested plateau of the Ardennes, varying from 1,200 to 2,200 ft. and sinks on the southern frontier to about 800 ft.

The one stretch of seacoast left to Belgium has a minimum value, except as an obstacle to invasion, for its shore waters are shallow and the coast line consists of sand dunes. The sands slope so gradually that the regular winds have thrown up a natural barrier of dunes, but for which, supplemented now by artificial dykes, the land would be submerged at every tide. Gaps have been left for drainage, one at each end and one in the center. These sandy beaches have made the Belgian coast a popular bathing resort. The estuary of the Yser offers a site for a fishing port

at NIEUPORT, the old port of YPRES being now 20 mi. inland owing to silting up of its waterway. The central gap obviously commands mail and passenger traffic for Brussels and the busiest fish trade. The packet station of OSTEND was naturally placed as far inland as possible, increasing the facilities offered by the good railway service for the distribution of fish. The northern gap, at the fishing port of Heyst, has been made the terminus of a ship canal from BRUGES and its new harbor train-ferry port of Zeebrugge, also a busy fishing port. Much care and money have been expended on this new port of Zeebrugge and many advantages have been claimed for it as it is on or near the greatest steamer routes of northern Europe. The port itself, the canal and the Bruges basin all have a minimum depth of 26 ft.

**Climate.** There are extremes of climate. The mean annual temperature at Ostend is about 50°. The Ardennes has a long, severe winter with heavy snow-storms and 134 days of frost, and rainfall is heaviest in this region. Two clearly marked and parallel belts of heavy rainfall may be distinguished. The first one is an area of mainly cyclonic rains in Flanders, eastwards of and due to, the dunes; and the other is where the cyclonic fall is more obviously accentuated by relief, southeast of the Sambre-Meuse trough. These belts are separated by a wide belt of much lighter precipitation.

**Education and Religion.** Improved means of education are at the disposal of the people, every commune being bound to maintain at least one elementary school for which the government pays one-sixth, the province one-sixth, and the commune the remainder. Colleges have been established in all the large towns. There are four universities: two at LIÈGE and Ghent supported by the State; Brussels University, founded and supported by voluntary contributions; and Louvain University (*see* LOUVAIN), established by the Catholic clergy. Almost the entire population is Roman Catholic. Protestantism is fully tolerated, but does not count many adherents.

**Production and Industry.** About three-fifths of the total area of the country is under cultivation, exceeding the pre-war acreage—an excellent example of reconstruction. Except for the marshy north and a somewhat sandy center, most of the basin of the Scheldt, especially towards the southeast, is distinctly fertile, and grows a great variety of crops. About one quarter of it gives two crops a year with very high yields. The principal crops of Belgium are oats, potatoes, sugar and fodder beets, barley and wheat. Home production can satisfy 84% of the national need, with an exception in the case of wheat of which 26% is home grown.

The country has long been one of the richest areas in the world in mineral wealth. In addition to large amounts of coal it had valuable iron, lead and zinc deposits. Consequently, manufactures requiring coal and metals were readily developed. Belgium has drawn upon her mineral wealth so actively that the zinc mines have been practically exhausted, and the

output of lead is small. The better ores are approaching exhaustion, and are being imported from France in increasing quantities. Coal output has increased steadily from about 17,000,000 tons a year in the '80s to upwards of 27,000,000 tons and Belgium has stood third in per capita consumption. The difficulty of obtaining coal is increasing, and it is now mined 3,000 ft. below the surface—the deepest anywhere—and seams only 18 in. thick are taken at a large labor cost.

Before the English had developed their extensive textile industries, Flemish weavers furnished a large share of the north European supplies of woollens and linens. Belgium maintains a high rank among the nations in the manufacture of linen and cotton. The average output of other manufactures from 1926 to 1929, amounted to about 4,000,000 tons of steel, 63,000,000 sq. yds. of window glass and 4,000,000 sq. yds. of plate glass.

**Transportation and Trade.** The river system is exceedingly useful, providing valuable waterways as well as water of first-rate quality for bleaching, dyeing and other purposes. It has been stated that the dense population of the country is based essentially on the development of the inland waterways. The fundamental advantage is that a small area of 11,755 sq. mi., forming practically the basin of a single river, is flanked by two concave curves of waterway, a sea flank from Nieuport to Antwerp and the river flank of the Sambre-Meuse between Mons and Maastricht. This was made the basis of a network of additional canals and canalized rivers which has enabled Belgium to meet the keen competition of Holland, Germany and France. The total length of inland waterway is over 1,250 mi., and this is supplemented so adequately by railways that several million tons of goods converge on Antwerp every year. The chief exports are textiles, iron and steel, glass, glassware and zinc. The principal imports are machinery, chemicals, skins, furs and cotton goods. The average value of exports for the period from 1925 to 1929 was \$750,000,000 and of imports \$850,000,000. Of the exports to the United States, about half by value were precious stones, chiefly diamonds. Rabbit skins valued at about \$4,000,000 were next, followed closely by plate glass for automobiles. Principal imports from the United States are: wheat, cotton, and automobiles.

**Finance.** Drastic and courageous methods employed after the World War, established financial stability in 1927. The coins as well as the weights and measures are similar to those of France in name and value. The proposed 1931 budget was: revenue 11,685,441 frs.; expenditures 12,305,184 frs.

**Government.** The form of government is a hereditary constitutional monarchy. The legislative power is exercised jointly by the king, the Senate and the Chamber of Representatives. The Senate consists of 154 members elected by the electoral colleges of the provinces, 40 by the provincial councils and 20 by the Senate. The king's sons become Senators at the

age of 18. The Senate is renewed completely every four years and Senators receive no honorarium. Representatives are elected for four years by direct vote of the people.

There are courts of appeal at Brussels, Liège and Ghent, with civil and criminal sections in each. The *Cour de Cassation* at Brussels can annul judgments of other courts and tribunals. Capital punishment is legal but is never carried out. H. A. A.

**BELGIUM, HISTORY OF.** Belgium is a state which was formed by political rather than by economic or by nationalist factors. As an independent kingdom Belgium dates only from 1830 and the lands forming it constituted no political individuality prior to the 16th century. Except for the North Sea the country has no natural frontiers and neither of the two languages spoken in it, Flemish (Dutch) or Walloon (French) is unique to Belgium.

The territory which is now Belgium was annexed to the Roman Empire by Julius Caesar in 57 B.C. and formed parts of the imperial provinces of Belgica and Lower Germany in the Diocese of Gaul. At the time of the Roman conquest the country was principally forest and marsh land. It was thinly populated by Celtic tribes and offered the Romans little but the strategic advantage of resting the left flank of their frontier on the mouths of the Rhine. The country was overrun by the German-speaking Franks in the 5th century and formed part of the Frankish kingdom of Austrasia under the Merovingians and early Carolingians. The Treaty of Verdun in 843 between the grandsons of Charlemagne divided the territory east and west along the Scheldt, assigning the western part to Charles the Bald and the eastern section to Lothair. The extinction of Lothair's line ended this arrangement, but the Scheldt became in general the boundary between France and the Empire.

In the Middle Ages there grew up west of the Scheldt the County of Flanders as a fief of the French crown. To the east were the County of Hainaut, the Duchies of Brabant and Luxemburg and the Bishopric of Liège, all embraced within the Duchy of Lower Lorraine as fiefs of the Holy Roman Empire. By the middle of the 14th century Brabant and Flanders had become the wool manufacturing center of Western Europe and Brussels, Antwerp, Ghent and Bruges had become thriving cities. The great commercial and strategic importance of the Belgian lands now placed them in their historic position as the cockpit of Europe, surrounded by powerful states each desirous of annexing them, and each equally zealous to prevent any other power from doing so. In 1384 the counties of Flanders and Hainaut passed to the Burgundian family which by 1451 had acquired most of what is now modern Belgium and Holland. In 1477 all these lands passed to the Habsburgs with the marriage of Mary, daughter of Charles the Bold, to the Emperor Maximilian. Their son, Philip, in marrying the daughter of Ferdinand and Isabella left to his son Charles, afterwards the Emperor of the Holy Roman Empire Charles V, both Spain and the

Netherlands. In 1555 Charles V divided his dominions, leaving to his son Philip II, the Netherlands and Spain and to his brother, Ferdinand I, the Austrian lands and the Empire.

**Spanish Control.** The bringing of the Netherlands—approximately the territory of present-day Belgium and Holland—under the domination of Spain proved unfortunate. Philip had been reared in Spain and did not understand the people of the Low Countries. He was soon looked upon as a foreign task master, for he levied heavy taxes, centralized the administration, depriving the provinces and cities of their much vaunted local autonomy, and proved intolerant of the fast spreading Calvinist doctrines. The hostility between King and subjects became so severe that arms were resorted to. At first all Netherlanders joined together according to the terms of the Pacification of Ghent, 1576, for common defense, but following Philip's promise to reform his administration the ten southern provinces made peace with him by the Treaty of Arras, 1579, leaving the seven northern provinces to continue the struggle alone. This separation into the Northern and Southern Netherlands was to become permanent and to form the basis for the modern states of Belgium and Holland, the boundary between them being that north of which Spain was unable to extend her sway.

The Southern Netherlands were ruled for a time by Spain as a dependency, then from 1598 to 1621 by Albert and Isabella, relatives of the reigning Spanish house, as a nominally independent state, and again from 1621 to 1713 by Spain as a subject territory. During this period the Spanish Netherlands, as they were called, accompanied Spain in her decay. They followed her in religion, and consequently suffered seriously from the emigration of Protestants. They followed her in politics, and hence their trade was ruined by Dutch and English blockades, especially by that of the former which prevented ships leaving Antwerp from reaching the open sea, and their frontiers were ravaged by the French, who slowly encroached on their territory. Finally when the Spanish branch of the Habsburgs ran out and France and Austria fought for the succession, the Southern Provinces were given to Austria in compensation for the Bourbon succession to the Spanish throne.

**Austrian Control.** For almost a century Austria ruled her new acquisition, now styled the Austrian Netherlands, and continued Spain's policy of granting the provinces almost complete autonomy. In order to forestall the French in their ambition of extending their territory to the natural boundary of the Rhine, the Northern or United Provinces were granted the right to maintain garrisons in the South by the Barrier Treaty, 1715. This precautionary measure was taken advisedly, for in the War of Austrian Succession, 1740-48, the French attacked the Southern Netherlands. Despite the presence of the Barrier troops, however, the French overran the country, but had to surrender it by the terms of the Treaty of Aix-la-Chapelle in 1748.

The Austrians had plans for the economic development of The Netherlands as well as for their protection from the French. Charles VI endeavored to revive the international trade of the Southern Low Countries by improving the port of Ostend and by founding the Ostend Company for the exploitation of foreign markets. Prospects for his enterprises seemed too bright to Great Britain and the United Provinces and they forced the Emperor to abandon his founding. Under Maria Theresa, however, Flemish agriculture and Walloon industries attained considerable prosperity, profiting by a long period of peace. Maria Theresa's successor, Joseph II, 1780-90, continued this plan for internal improvements, but he wanted to carry his reforms too far. He was imbued with the philosophy of the age and thought that as an enlightened despot he could bring about the millennium in the Southern Netherlands by the use of his reason. All his schemes were abortive, however, and led to the Brabant Revolt, an insurrection on the part of his subjects.

With the outbreak of the French Revolution, the Revolutionary armies promptly overran Belgium and the Treaty of Campo Formio in 1797 definitely ceded Belgium, along with the left bank of the Rhine, to France. Throughout the entire Republican and Napoleonic period Belgium constituted an integral part of France, under French administration and French law.

**Revolt and Independence.** For a few months following the overthrow of Napoleon, a temporary Austrian government was reestablished in the Southern Netherlands, but the Congress of Vienna in 1815 joined them with Holland and Luxemburg to form the Kingdom of The Netherlands, with William I, the King of Holland, as ruler. This was in no sense a merely personal union, except for that part of Luxemburg which is now the independent duchy, but a single country with one unified government and administration. It worked badly. There were nearly 3,500,000 Belgians to 2,000,000 Dutch, but all branches of the administration were overwhelmingly Dutch in personnel. To make matters more difficult the bulk of the Dutch were Protestant and nearly all the Belgians Catholic, the French-speaking Belgians admired French doctrinaire liberalism and disliked the idea of a kingdom even more than they disliked the Dutch, and above all, King William was extraordinarily tactless and obstinate. On the other hand the union had economic advantages for the South, opening the Scheldt to the commerce of Antwerp and giving a stimulus to industrial enterprise. Ecclesiastical difficulties in Belgium were settled in a Concordat between the Kingdom and the Papacy in 1827, which seemed satisfactory to Rome but not to Belgian Catholics. Finally in 1828 common dislike for the Dutch led the Catholic and Liberal parties to ignore their own differences and to unite for independence. Revolution followed and, with the aid of the French, the Southerners drove out the Dutch. Although Russia, Austria, Prussia and England opposed this trifling

with the arrangements of 1815, they were all too occupied with other matters and concerned over the attitude of France to intervene. Finally after repeated conferences at London the powers accepted the *fait accompli* of Dec. 20, 1830, recognized Belgian independence and guaranteed her neutrality. The Dutch refused to consent to this arrangement at once, but in 1839 accepted the arrangement and ratified the treaties.

The constitution which was set up by the Belgians provided for a parliamentary government with high property qualification for voters. The Catholic-Liberal coalition which had gained independence continued to govern for many years. Leopold I proved an able and devoted king and attempted to turn the energies of the Belgians from politics to economic activity. In 1847 the Liberal Party came into power and lowered the property qualifications for voters, a factor which contributed greatly to the ease with which Belgium passed the revolutionary crisis of 1848. Again from 1857 to 1870 the Liberals held power, adopted free trade and encouraged a policy of industrial development, particularly of mining, metallurgy, and glass and textile manufacture. Leopold I died Dec. 10, 1865 and was succeeded by his son Leopold II. Religious difficulties arose in 1877 when the Liberal Party attempted to institute secular education, but the return of the Catholic Party to power in 1884 again secured the control of education to the Catholic Church. The increasing industrialization of the country developed a strong socialist movement. Agitation for universal suffrage and higher wages led to serious rioting in 1892 and the adoption of universal plural suffrage the next year. Meanwhile the movement to supplant the French language with Flemish had increased and in 1898 the government was forced to declare Flemish equal to French before the law. In 1908 the independent Kingdom of the Congo, over which Leopold II ruled, became a Belgian colony. Leopold II died Dec. 17, 1909 and was succeeded by his nephew Albert.

Belgium had a negligible standing army and a reserve of only questionable value, when the World War broke out, but had built what were considered very powerful fortifications at Liège, Namur and Antwerp. Moreover she had concluded a military convention with England regarding the possible landing of British troops, and considerably strengthened her army in the years just before the War. On Aug. 2, 1914 Germany delivered an ultimatum to Belgium demanding free passage of German troops under pain of being treated as a hostile power. Belgium, having declared her neutrality on Aug. 1, refused the German ultimatum and mobilized. Germany declared war against France on Aug. 3 and invaded Belgium the next day. To the great surprise of the Allies the forts of Liège proved unable to stand up under the German guns and surrendered on Aug. 8, leaving all northern Belgium unprotected. Once the fall of Liège had opened the road into France, Germany thereupon occupied almost all of



the country with little resistance except at Antwerp. Belgian *franc-tireurs* were suppressed with great severity. Germany appointed governors-general for Belgium and at first maintained some Belgian civilian government. This, however, gradually gave way to almost complete dictatorship. On the agreement by Germany to allow neutral supervision and not to requisition food imported to the Belgians, the Allies permitted such supplies to pass their blockade. Meanwhile after Oct. 17, 1914 the Belgian government sat at Havre administering the Belgian Army. War conditions soon brought the Germans to exert very severe pressure upon Belgian industry and labor, and finding many of the industrial plants antiquated and useless scrapped them and drafted the released labor supply to work in the industrial districts of Germany and occupied France, some 50,000 men to each. Germany likewise attempted to encourage the Flemish movement, which was then a movement for the elevation of the Netherlandish or Flemish culture and the Netherlandish language in Belgium. The invaders suggested to the Flemish leaders that the movement would only be a success if Flemings enjoyed political autonomy, and they intimated that this would be possible if Flanders cooperated with Germany. To such suggestions most of the Flemings turned a deaf ear but a minority listened, and agreed, and sought an autonomous Flanders under German leadership.

At the peace conference Belgium was restored to her former condition and was given the previously neutral Moresnet and German Eupen and Malmedy. The problems of reconstruction which faced the Belgian government after the departure of the Germans were largely financial, since only small parts of Belgium had been destroyed during the course of the war. The railroads, however, had seriously deteriorated and the problem of rebuilding the dismantled factories forced the government to negotiate large loans from the United States. The necessity of acquiring modern equipment soon proved of considerable benefit to Belgian industry and resulted in greater production than had been attained during the pre-war period. Heavy borrowing left a financial difficulty which brought on a severe money crisis in 1926. Foreign bonds were refunded, the state railways being pledged as security and the currency was stabilized at a permanently lower level, heavily discounting internal obligations. A rail, custom, and consular union was effected with Luxemburg and in 1920 a military alliance was concluded with France. The Flemish question has continued to trouble Belgium, especially since those radical elements who desire a change in the political structure of the state are becoming more numerous. In Jan. 1929, the Flemings secured an amnesty for their fellows who had cooperated with Germany during the war and in 1930 saw the University of Ghent become a Flemish institution.

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**BELGRADE**, Serbian *Beograd*, the capital of the kingdom of YUGOSLAVIA, situated on the Sava and the Danube rivers. The city is spread out along the river-side amid low hills. An ancient citadel, used as prison and barracks, surmounts the town. There are still some remains of Turkish occupancy left in the obscure quarters, but Belgrade has grown into a modern capital with imposing new buildings and wide streets. Among the notable structures are the royal palace, recently enlarged and improved, the cathedral of the Serbian Metropolitan, the national museum, national library and the *Skupshina*, or parliament house.

Belgrade is the cultural and educational center of Yugoslavia, with a military academy, theological seminary, teachers' and commercial colleges and the University of Belgrade. Among the parks and monuments the most important are the Kalmegdan Gardens behind the citadel, the botanical gardens, and the monument to Prince Michael.

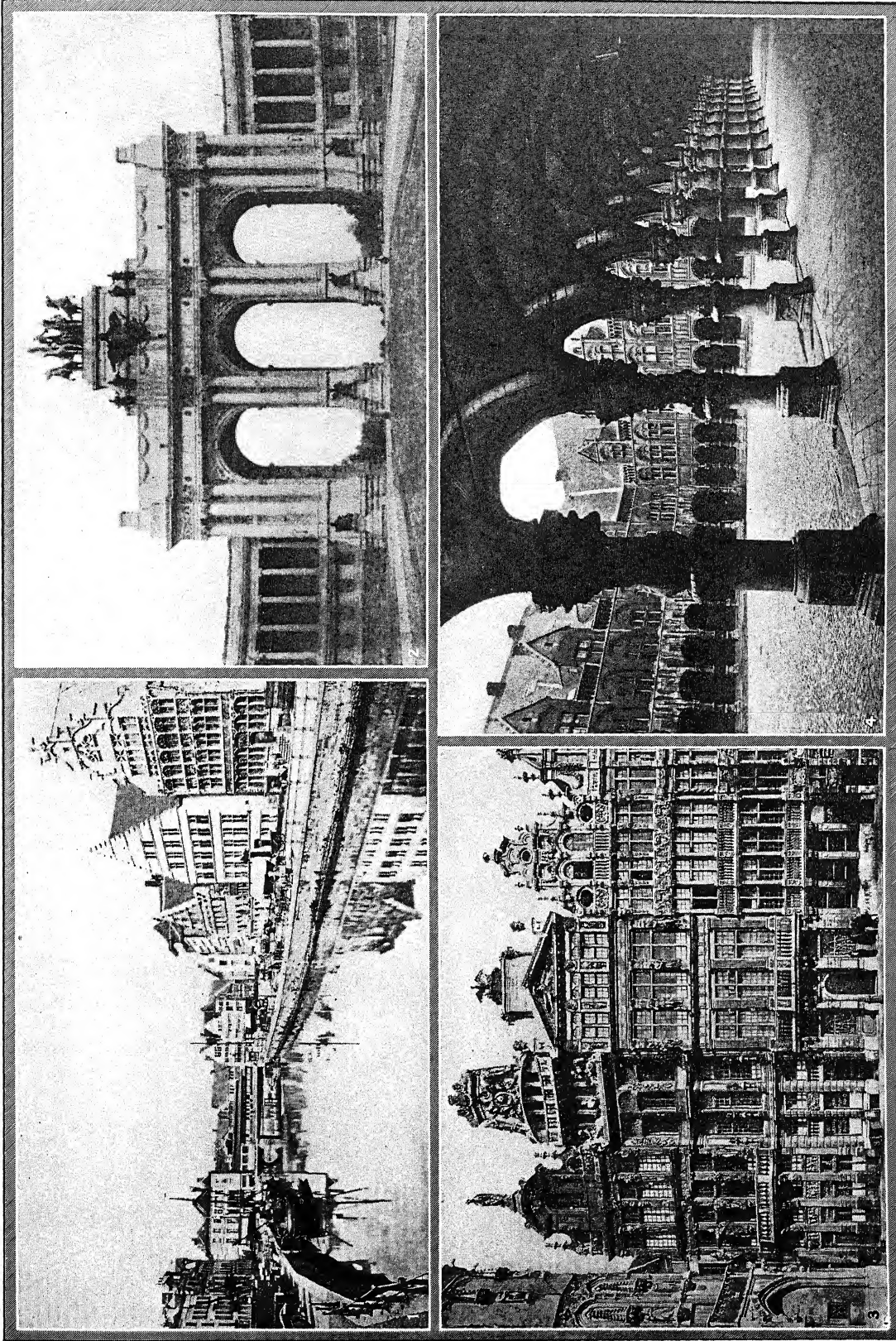
As a railroad center Belgrade occupies a vital position in the Balkan peninsula. The Paris-Constantinople railway passes here and meets at Nish the Skopje line, which joins the Greek railway at Ghevgheli for Salonika and Athens. Branches connect the capital with Sarajevo, Ragusa, Spalato or Split and Sebenico. Belgrade is also the center of the commercial and financial interests of the kingdom. The national bank has its headquarters here, and there are numerous trade associations and a chamber of commerce.

In the 3rd century B.C. the city was a Celtic fort, called Singidunum. Having suffered the invasions of Sarmatians, Goths and Gepids, it was recaptured for Rome by the Emperor Justinian, but fell to the Franks in the 8th century and to the Bulgarians in the 9th. The Bulgarians held it until the 11th century, when Emperor Basil II conquered it for Byzantium. Since Belgrade was the center of commerce between Hungary and Serbia and on the Danube, the town was a constant objective of Hungarian, Bulgarian, Byzantine and Serbian invaders until 1521, when it passed into the hands of the Turks, from whom the Austrians took it in 1688. It again came under Turkish domination, however, and was not freed until the Serbs attempted to gain their independence in 1807. In that year they occupied the town, but it did not become the capital of free Serbia until the Russo-Turkish War of 1877-78. Belgrade, shelled by the Austrians in the first action of the World War, was captured by them in Nov. 1914. The Serbians, however, retook their capital, only to see it again overrun by the Central Powers who held it until the end of the World War. It then became the capital of the newly-created Yugoslav Kingdom.

The leading industries of Belgrade are iron works, breweries, and the manufacture of boots, sugar, glue, soap, preserved meat, pottery and sweets. Lead mines and stone and marble quarries are found near the city. Pop. 1931, 241,542.

**BELGRANO, MANUEL** (1770-1820), Argentine patriot, was born in Buenos Aires. He studied law in

# BELGIUM

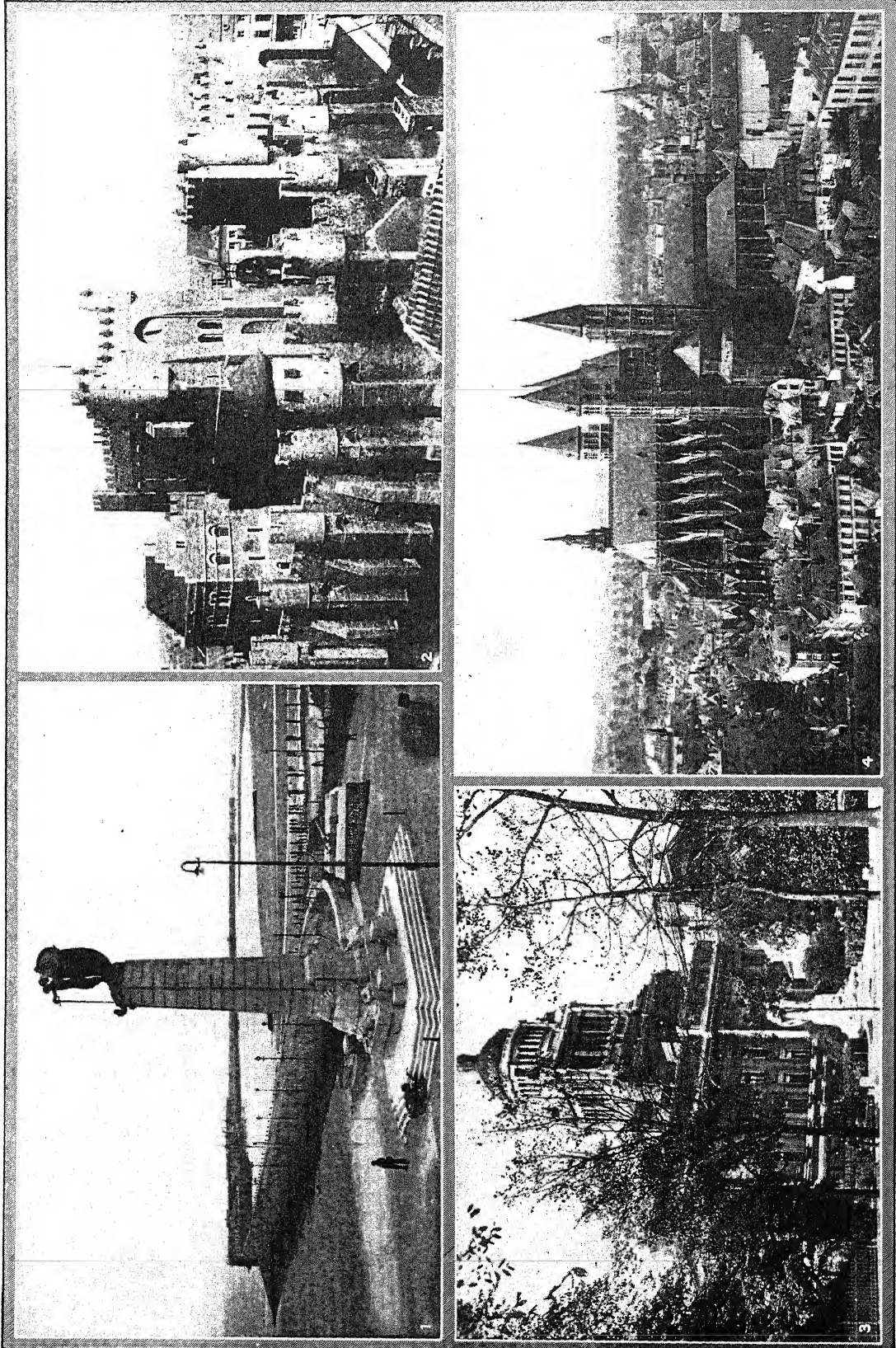


2, 3, 4, COURTESY CONSULATE GENERAL OF BELGIUM

## MEDIEVAL AND MODERN BELGIUM

1. Le Quai aux Herbes, Ghent.
2. Arc du Cinquantenaire, connecting the wings of the Palace of Cinquantenaire in Brussels, built by Leopold II, 1905.
3. Grand Place, or market place, a noted medieval square, Brussels.
4. The Palace of the Bishops at Liège.

## BELGIUM



### HISTORIC LANDMARKS OF BELGIUM

1. British Memorial to the men killed during the attack upon the German submarine base at Zeebrugge, 1918.
2. Castle of the Counts, Ghent.
3. The Palace of Justice, Brussels.
4. The medieval Cathedral of Tournai.



Valladolid and Madrid, Spain, and returned to play a distinguished rôle as secretary of the Consulado or gild merchant of his native city. He served as a captain of militia in 1806 when the English attacked Buenos Aires. In 1810 he was a member of the patriot Junta, and as general was sent to conquer Paraguay but failed. As commander of the Army of the North he defeated the Spanish General Pio Tristan in a series of battles in 1812 and 1813; but when, in 1813, he lost the battles of Vilcapujio and Ayohuma he was superseded by General Jose de San Martin. After a mission to Europe to negotiate for the establishment of a constitutional monarchy in Argentina, 1813-15, he returned and again became head of the Army of the North. He remained in this place until his health failed in 1819 and he returned to Buenos Aires where he died in 1820. It was he who devised the national flag of Argentina.

**BELISARIUS** (c. 505-565), Byzantine general under the emperor JUSTINIAN, was born in Illyria. Belisarius commanded the eastern armies of the empire (529-532). In 533 he took Carthage, the capital of the Vandal Empire in Africa, and later (534-540) won decisive victories over the Goths in Italy. In 559 he saved Constantinople from the Bulgars. He was imprisoned by Justinian in 562 for alleged conspiracy, was eventually freed and died Mar. 13, 565.

**BELITOENG**, an island of the Dutch East Indies. See BILLITON.

**BELIZE**, the capital of BRITISH HONDURAS, and the chief port, built on the banks of a branch of the main mouth of the Belize River, on the Caribbean Sea near the island of Turneffe.

The coast is fringed throughout its entire length from the Gulf of Honduras to Yucatan by a continuous line of coral reefs, which serve as the offshore breakwater for an inner channel navigable by native craft. The Belize washes down sedimentary matter which has formed a long alluvial peninsula advancing beyond the normal shore-line. Easy access is afforded to the harbor, however, by a broad passage which pierces the fringing coral reefs and is navigable to ocean-going vessels. The town of Belize lies close to the waterside, where most of its wooden houses are supported by piles rising only 2 or 3 feet above highwater level. There is a beautiful park, and the town is fairly healthful. Effective sanitary measures and the ever-present sea breezes have minimized the danger of disease from mosquito infection, and malaria and yellow fever are no longer common. The principal exports are mahogany, chicle, copra, bananas and rum. Pop. 1921, 12,661.

**BELKNAP, JEREMY** (1744-98), American historian and clergyman, born at Boston, Mass., on June 4, 1744. He attended a private school until his 14th year, and then entered Harvard, where he graduated in 1762. While teaching school in Massachusetts he studied for the ministry, and was ordained in 1766 at Dover, N.J. At the outbreak of the Revolutionary War he was appointed chaplain to

the state troops, but declined on account of poor health. In 1786 he surrendered his parish at Dover, and in 1787 became pastor at the Federal Street Church, Boston, where he served the rest of his life. In 1790 he drew up the plans for the Antiquarian Society of Boston; from this group grew the Massachusetts Historical Society, chartered in 1794, the first organization of its type in the United States. He died on June 20, 1798. His worth as a historian is measured chiefly by the *History of New Hampshire*, a work of three volumes, published in 1784, 1791 and 1792, on which he spent 20 years. He also published *The Foresters*, 1792; *American Biography*, vol. I, 1794, vol. II, 1798 (posthumously); numerous essays and discussions on religious matters; and a book of hymns for use in the Congregational Church, 1795.

**BELL, ALEXANDER GRAHAM** (1847-1922), inventor of the speaking telephone, was born in Edinburgh, Scotland, Mar. 3, 1847. He was the son of a famous professor of elocution and inventor of a system of "visible speech," in which young Bell became much interested. In 1870 he emigrated to Brantford, Ont., and was soon afterward asked to lecture on vocal physiology at Boston University. In July 1875 he finished the first speaking telephone which in its fundamental structure is identical with the elaborate apparatus of to-day. The first public exhibition of the operation of his invention was made at the Centennial Exposition in Philadelphia on June 25, 1876, in the presence of many distinguished men, including the emperor of Brazil. Bell also invented the photophone, the audiometer and a method for locating metallic objects in human bodies. He had a pronounced interest in eugenics, longevity and aviation. He died near Baddeck, Nova Scotia, Aug. 2, 1922, and during his burial all telephone communication on the North American continent was suspended.

**BELL, ALEXANDER MELVILLE** (1819-1905), Scottish-American educator and inventor of "visible speech," was born at St. Andrews, Scotland, Mar. 1, 1819. He wrote many works on elocution and shorthand, chief among which are *Visible Speech*, *Principles of Phonetics* and *World English*, the latter being an adaptation of the Roman alphabet to phonetic spelling of English. He died in Chicago, Ill., Aug. 7, 1905.

See John Hitz, *Alexander Melville Bell*, 1906.

**BELL, ANDREW** (1753-1832), Scottish teacher and clergyman, was born at St. Andrews, Scotland, Mar. 27, 1753. He is noted as the founder of the MONITORIAL SYSTEM of education. Bell lived in America from 1774-81, and in 1787 Bell went to India, where he was head of an orphan asylum at Madras. Here he originated his system of education by cooperative effort. He died at Cheltenham, England, Jan. 27, 1832.

**BELL**, a hollow vessel generally made of glass or metal which gives off sound when struck. Although an instrument may be made of hollow tubing (used especially in connection with chimes), it is more often

cup-like in shape and is equipped with a loose ball or clapper suspended from the apex of the interior. In large and very fine bells an alloy of copper and tin, called "bell metal," is used so that the instrument will give forth a pure, resonant note.



THE BELL OF MONSERAT  
Mission Inn, Riverside, California

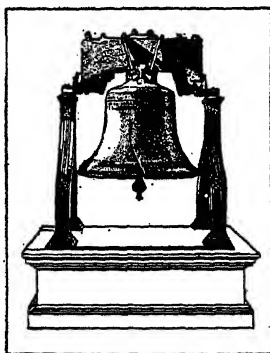
Since the first centuries of the Christian era, bells have been familiar objects in the lives of the people, being used as a summons, signal or warning in addition to the functions they performed in religious ceremonies. Bell-ringing was at one time considered a fine art, its practitioners forming their own guilds and organizations.

Among the world's best known bells may be included the *Liberty Bell* at Philadelphia, Pa., the huge *Czar Kolokol* at Moscow, which has never been rung because of imperfection in the casting, *Big Ben* at London, and the *Bourdon*

in the Rockefeller carillon at the Riverside Church, New York City. See also CARILLON.

**BELL**, a city and suburb 6 mi. south of Los Angeles, in Los Angeles Co.; served by the Union Pacific Railroad. The chief crops of the region are vegetables, alfalfa and citrus fruit. The local industries include automobile motor valves, tiles, steel and ornamental iron products. Pop. 1930, 7,884.

**BELLABELLA**, an important Kwakiutl tribe speaking the Heiltsuk dialect of the Wakashan stock. The Heiltsuk, as they call themselves, live on Milbank Sound in British Columbia. Surrounded as they were by alien tribes, the Chimmesyan and the BELLA COOLA and dwelling in the pathway of the raiding parties of the Haida, the Heiltsuk like their neighbors were a warlike people. Like their northern neighbors they maintained a system of clans with maternal descent, and secret societies typical in Northwest Coast culture which can best be characterized by its large dependence upon the products of the sea for food, and the preeminence in wood working. The Heiltsuk have long been in contact with European civilization and have been Christianized, so that only remnants of their ancient culture survive.



AFTER RAU PHOTO. PHILADELPHIA  
THE LIBERTY BELL, INDEPENDENCE HALL, PHILADELPHIA

**BELLA COOLA**, the Kwakiutl Indian name by which they are known, given to a group of tribes forming the most northerly division of the Salish linguistic stock, which is in the main the language of the Indians of the interior of British Columbia. The population at present has dwindled down to a few hundred. The Bella Coola live on north and south Bentinck Arm, Dean Inlet and along the Bella Coola River in British Columbia, and are culturally most closely allied to the Kwakiutl, although those groups living further inland on the Bella Coola have many traits in common with the culture of the Chilcotin and other interior peoples speaking Athapaskan languages. Unlike their neighbors on the Coast to the north, who have a clan organization, the Bella Coola are divided into endogamous villages. Their ceremonies, like those of the Kwakiutl, consist mostly of dramatized presentations of family traditions accompanied by lavish distribution of property. Like the other Indians of the Northwest Coast their existence is chiefly dependent upon the products of the sea.

**BELLADONNA**, a preparation from the leaves and tops of *Atropa Belladonna*, or deadly nightshade. The belladonna leaves, which are poisonous, are chiefly used in the form of tincture of belladonna, extract of belladonna, belladonna plaster and belladonna ointment. The dried roots are also used in medicine. The action of belladonna is very similar to that of ATROPINE.

**BELLAIRE**, a city of Belmont Co., Ohio, on the Ohio River, about 5 mi. from Wheeling, W. Va. The Baltimore and Ohio and the Pennsylvania railroad lines serve the city, which also has bridge and steamboat connections. Its manufactures, derived largely from natural resources of the vicinity which include clay and limestone, comprise iron and steel products, glass, enamelware, farm tools, caskets and stoves. In 1929 the total retail trade amounted to \$5,004,132. Bellaire handles the chief output of Belmont Co. coal and is well known for its Jersey cows. Fruit-growing and dairying are other local interests. Pop. 1920, 15,061; 1930, 13,327.

**BELLAMY, EDWARD** (1850-98), American author and journalist, was born at Chicopee Falls, Mass., Mar. 26, 1850. After completing his education in Germany he studied law, but abandoned that profession for journalism, being first employed on the New York *Evening Post*, and later founding the Springfield *Daily News*. He achieved wide fame and popularity with his fanciful novel, *Looking Backward; or 2000-1887*, in which he expounded some of his socialistic theories, and described startling inventions of the future, many of which have since become realities. Other novels, including *The Duke of Stockbridge*, had only a partial success. Bellamy died at Chicopee Falls, May 22, 1898.

**BELLAY, JOACHIM DU**. See DU BELLAY, JOACHIM.

**BELL, BOOK AND CANDLE**, a frequent literary allusion derived from an obsolete medieval ceremony accompanying the greater excommunication.



The priests carried lighted candles, which they threw down after the bishop had pronounced sentence. This signified the quenching of hope; the tolling of the bell signified spiritual death and annihilation.

**BELLEAU WOOD, BATTLE OF**, the second important American action in the WORLD WAR. In the German offensive of 1918 along the Aisne, Ludendorff had created a salient extending from Soissons south to Château-Thierry, and thence east to Rheims. Only the worn VI French army stood in the way of a German break-through west of Château-Thierry, in the direction of Paris. The 2nd American division was sent to support the French. Meanwhile the Germans strengthened their lines, preparing to continue the advance from Vaux and Belleau Wood, a forest tract about one square mile in area, lying five miles northwest of Château-Thierry. The difficult task of ejecting the Germans from Belleau Wood, infested with machine-guns, fell to the celebrated 4th Brigade of Marine Corps, attached to the 2nd division and commanded by Gen. Harbord. On June 6 the attack was launched. Bitter fighting continued for 10 days, engaging the entire 2nd division, until Belleau Wood was taken, together with Bouresches and Vaux. The German direct advance along the Château-Thierry-Paris road was accordingly cut short. American casualties were heavy, totaling 285 officers and 7,585 men killed, wounded and missing.

**BELLE DAME SANS MERCI, LA**, (literally, "The Fair Lady without Pity"), the title of a well-known ballad by JOHN KEATS. In this poem a knight one day meets a beautiful lady and, enchanted by her beauty, goes with her to an elfin bower. He listens devoutly to her vows to love him for ever and truly, but at last awakening from his enchantment, he finds himself alone on a cold hillside.

**BELLEFONTAINE**, a city in western Ohio, the county seat of Logan Co., situated 56 mi. northwest of Columbus. It is served by bus lines, trolleys and the New York Central and the Big Four railroads. The chief crops in this region are corn, wheat and timothy. The principal industries are railroad shop work and the manufacture of bridges, steel products and automobile bodies. Bellefontaine was laid out in 1820, the city limits being fixed to include the so-called Big Spring; incorporated in 1835. The city was swept by fire in 1856. Pop. 1920, 9,336; 1930, 9,543.

**BELLE ISLE, STRAIT OF**, a water passage between Labrador and Newfoundland, connecting the Gulf of St. Lawrence and the Atlantic Ocean. It is about 35 mi. long, with a breadth of from 10 to 15 mi. The island of Belle Isle, an uplift of granite cliffs, guards the Atlantic entrance. The strait was the first approach to the St. Lawrence River to be discovered by early explorers. It is navigable during the summer months.

**BELLEROPHON**, in Greek mythology, son of GLAUCUS, King of Corinth. While in Argos he incurred the anger of King Proetus who sent him to Iobates, King of Lycia, with a sealed request to kill

him. Instead Iobates set him the task of killing the CHIMERA. This he was enabled to do through Pallas's (see ATHENA) gift of the winged horse PEGASUS.



COURTESY M. OF FINE ARTS, BOSTON

BELLEROPHON ATTACKING THE CHIMERA

From a Proto-Corinthian vase of the 7th century B.C.

**BELLES-LETTRES**, a term in literature taken from the French signifying "fine literature," a term loosely applied to literature in which taste and imagination predominate. Thus, POETRY, DRAMA, FICTION, LITERARY CRITICISM and the ESSAY might be considered to come under this heading, but works of science or textbooks, no matter how well written, would not. The expression was first used by SWIFT in *The Tatler*.

**BELLEVILLE**, county town of Hastings Co., Ontario, Canada, and port of entry for the Canadian customs, situated at the confluence of the River Moira and Bay of Quinte, 113 mi. east of Toronto. Exporting largely over Lake Ontario and St. Lawrence River routes, it is the distributing center for the farm, orchard and dairy produce of the region. A Canadian Government airport lies 10 mi. west. Planing mills, cement works and cheese, builders' hardware, industrial alcohol, optical goods, radio, automobile accessory and men's clothing factories are among local industrial firms. A pleasant industrial city, Belleville numbers among its educational institutions Albert College, affiliated with Toronto University and the Ontario School for the Deaf. Founded by Empire Loyalists in 1790, it was incorporated in 1878. Pop. 1921, 12,206; 1931, 13,798.

**BELLEVILLE**, a city of southwestern Illinois and county seat of St. Clair Co., 14 mi. southeast of St. Louis, Mo. It is situated on three railroads and a belt line connecting at East St. Louis with many railroads. Scott Field, 8 mi. east of Belleville, is a training-school and base of supply for the U.S. Army air service. Farming and coal mining are the chief interests of the vicinity. Belleville manufactures stoves and heating apparatus, farming implements and other commodities. In 1929 the value of the factory output was about \$20,000,000; the retail trade amounted to \$11,952,415. Numerous points of interest accessible from Belleville are Cahokia Mounds State Park; Ft. Chartres in Raymond Co., built by the French in 1717; Garrison Hill Cemetery, site of Ft. Kaskaskia; and the home of Pierre Menard, first lieutenant governor of Illinois, 1818. The first settlers came about 1806. Pop. 1920, 24,823; 1930, 28,425.

**BELLEVILLE**, a town of Essex Co., N.J., located on a gentle slope on the west bank of the Passaic River, immediately north of Newark and 9 mi. west of New York City. It is served by two branches of the Erie Railroad, buses and electric trolleys. While

mainly a residential suburb of Newark and New York City, Belleville has many local manufactures which include Fourdriniers, wire cloth, metal goods, hats, brushes, chemicals, automobile tires and machinery. In 1929 the industrial output reached approximately \$27,000,000; the retail trade amounted to \$6,991,349. It was separated from Bloomfield township in 1839 and was incorporated as a town in 1910. Pop. 1920, 15,660; 1930, 26,974.

**BELLEVUE**, a residential suburb of Cincinnati, O., on the Kentucky side of the Ohio River in Campbell Co. The city is served by river craft and two railroads. The chief industry is quarrying. Bellevue was founded in 1866 and chartered in 1870. Pop. 1920, 7,379; 1930, 8,497.

**BELLEVUE**, a city of northern Ohio, in Sandusky and Huron counties, situated 70 mi. southwest of Cleveland. It is served by four railroads. Fruit, vegetables and grain are the chief crops of this region. Bellevue has farm machinery, stove, and motor truck factories, railroad shops, flour mills and canneries. Beneath the city are underground crevices which carry off the surface water, possibly to Lake Erie. Bellevue's sewage is drained by a system of wells, one connected with each building, which are drilled into these crevices. Pop. 1920, 5,776; 1930, 6,256.

**BELLEVUE**, a residential suburb and borough of Allegheny Co., in southwestern Pennsylvania, situated on the Ohio River, not far distant from Pittsburgh. River craft and the Pennsylvania Railroad afford transportation. The retail business in 1929 amounted to \$3,576,269. There are coal mines and gas wells in the vicinity. Bellevue was incorporated in 1867. Pop. 1920, 8,198; 1930, 10,252.

**BELLEW, HAROLD KYRLE** (1857-1911), English actor and playwright, was born at London, Apr. 14, 1857. After playing leading parts in London he made his debut in the United States in *In His Power*, 1885, at Wallack's Theatre in New York. In 1887 he appeared with Mrs. James Brown Potter in *Hero and Leander*. He played Marat in *Charlotte Corday* in 1895 and appeared as Romeo in New York in 1896. His best rôles in the United States were in *Raffles*, 1906, and in *Brigadier Gerard*. Bellew died at Salt Lake City, Utah, in 1911.

**BELLFLOWER**, the common name for a numerous genus (*Campanula*) of herbaceous plants of the bellflower family many of which are choice garden ornamentals. Well known species are the HAREBELL (*C. rotundifolia*), Canterbury bells (*C. medium*) and rampion (*C. Rapunculus*). See also CAMPANULA.

**BELLIGERENCY**, a status in law and in fact, which is accorded insurgents who have proved themselves able to prosecute actively and effectively a civil war. Insurgents (see INSURGENCY) may seek only to secede, or they may seek to overthrow altogether the authority of the titular government. Such insurgents must have a political organization, must control and exercise authority over a definite amount of territory and must be willing and able to discharge their obligations as a belligerent. The legal effect of the recog-

nition of belligerency is to extend to the insurgents the rights of war along with its responsibilities.

**BELLINGHAM**, an industrial and shipping center in northwest Washington, situated about 20 mi. from the Canadian border on the eastern shore of Bellingham Bay, an inlet of the Strait of Georgia. The city, which is the county seat of Whatcom County, is noted for its picturesque setting above the waters of the bay, with the Cascade Mountains in the background. Lofty Mt. Baker is about 30 mi. to the east. Three railroads add to the shipping facilities of the city—the Great Northern, the Northern Pacific, and the Chicago, Milwaukee, St. Paul and Pacific. Among the principal buildings are the Herald Building, Bellingham National Bank Building, and a normal school. Industries, based on the natural products of the region, include lumber and paper mills, cement plants, the canning of fruit and fish, the manufacture of beet-sugar, and the export of poultry, eggs and dairy products. Coal and limestone are produced in the vicinity of the city. Bellingham received its charter in 1904. Pop. 1920, 25,585; 1930, 30,823.

**BELLINI, GENTILE** (c. 1427-1507), portrait painter and medaillieur, was born probably at Padua about 1427, the son of Jacopo Bellini, one of the first painters in oil. With his brother, Giovanni, he decorated the Council Chamber of the Doge's Palace, Venice. Mohammed II invited Gentile to Constantinople where he executed various historical works and a noted portrait of the Sultan. His most famous painting is *The Preaching of St. Mark*. The artist died at Venice, Feb. 22, 1507.

**BELLINI, GIOVANNI** (c. 1428-1516), Italian painter, founder of the Venetian school, was born probably at Padua about 1428. He was the son of Jacopo Bellini and the brother Gentile Bellini. His works are characterized by warmth and intensity of color. His *Infant Jesus, Holy Virgin* and *Baptism of the Lord* are famous. His altar-piece at Pesaro, *The Coronation of the Virgin*, ranks among the great Renaissance paintings, as does his portrait of Doge Leonardo Loredano, now in the National Gallery, London. Titian and Giorgione were his pupils. Bellini died at Venice, Nov. 29, 1516.

**BELLINI, VINCENZO** (1802-35), Italian opera composer, was born at Catania, Sicily, Nov. 7, 1802. He attended the conservatory of Naples and was instructed in composition by Tritto and Zingarelli. He belonged to the school of G. A. Rossini. Bellini's chief works are *Bianco e Fernando*, *Il Pirata*, *La Straniera*, *Zaira*, *I Capuletti ed i Montecchi*, *La Sonnambula* and *Norma*; the latter two belong to the standard repertory of opera to-day. He died at Paris, Sept. 23, 1835.

**BELLINZONA**, a city of Switzerland, capital of the canton of Tessin on the St. Gotthard railway. A collegiate church in Italian style, three castles, old walls and towers give it a medieval aspect. Industries include repair shops of the railroad. Most of the inhabitants are Italians. Pop. 1930, 10,873.

**BELLMAN, KARL MIKAEL** (1740-95), Swedish poet, was born at Stockholm, Feb. 4, 1740. He attended the University of Upsala for a few years but soon gave up his studies and became a bank clerk in Stockholm. Here he accumulated so many debts that he was compelled to flee to Norway but later returned. He wrote many songs for the amusement of himself and his friends. They were chiefly drinking and love songs, and they became so popular that they were collected by others and published, finding favor with King Gustaf III. Bellman's works are included in *Bacchanalian Songs*, *Fredman's Epistles*, *Fredman's Songs* and other collections. He died at Stockholm, Feb. 11, 1795.

**BELL METAL.** See TIN AND ITS ALLOYS.

**BELLO, ANDRÉS** (1781-1865), South American author, was born in Caracas, Venezuela, Nov. 29, 1781. On maturity he devoted himself to classical studies. Sent to England in 1810 to secure British support in the Venezuelan war of independence, Bello decided to remain in London and continue his studies. He taught for a living and contributed many articles to the *Repertorio Americano*. In Venezuela he had begun a philological study of Spanish conjugations (1810-40); in London he turned to poetry and sociology. He was also secretary of the Colombian legation. In 1829 the Chilean government called him to Santiago, where he was made director of *El Araucano*, official paper of the nation. He was the first rector of the University of Chile, founded in 1842, and taught Roman law, political science and the humanities. Bello was appointed by the United States as arbitrator in a dispute with Ecuador, and the next year he performed the same service in a dispute with Colombia and Peru. He was the author of the Civil Code of Chile and he is considered by Spanish critics as one of the masters of the Spanish language. A partial list of his works follows; for the last named he was made an honorary member of the Royal Spanish Academy: *Alocución a la poesía*; *Silva a la agricultura de la zona torrida*; *Ortología métrica*; *Principios de Derecho Internacional*; *Gramática de la Lengua Castellana*. P. V. S.

**BELLOC, HILAIRE** (1870- ), English writer, whose full name is Joseph Hilaire Pierre Belloc, was born in France, July 27, 1870. He was graduated at Oxford and served in the British House of Commons from 1906 to 1910. He is best known as a brilliant historian whose work is tinged with Catholicism. Among Belloc's works are *Verses and Sonnets*, 1895, *The Bad Child's Book of Beasts*, *The Modern Traveller*, *General Sketch of the European War*, 1915, *The Free Press, Europe and the Faith*, 1920, *The House of Commons and Monarchy*, *The Jews*, 1922, *The Mercy of Allah*, 1922, *Joan of Arc*, 1929, and *Riche-lieu*, 1930.

**BELLO HORIZONTE**, capital of the inland state of Minas Geraes, Brazil, on a plateau with an elevation of 3,000 ft. It is an attractive, progressive town and has a mild and pleasant climate. When the capital was to be changed from Ouro Preto, the state built

Bello Horizonte for the purpose of locating the capital here. It has gas, a good water supply and many other modern improvements. Pop. 1920, 55,563; est. pop. 1930, 108,849.

**BELLONA**, Roman goddess of war, the sister or wife of Mars. Appius Claudius built a temple to her in the Campus Martius, in 296 B.C. Bellona is represented wearing a helmet and carrying a shield and firebrand. Her priests, called *Bellonarii*, made offerings of blood on her festival, held Mar. 20.

**BELLOWS, GEORGE WESLEY** (1882-1925), American painter and lithographer, was born at Columbus, O., Aug. 12, 1882. After graduation from Ohio State University, Bellows came to New York to study oil painting under Robert Henri. The first of his paintings to draw attention was a street scene called *Forty-Two Kids*, dated 1907. Masses of common folk and children fascinated him and he devoted many canvases to this theme. Sports in general and prize fighting in particular alike absorbed his interest. At the age of 27 Bellows was elected associate member of the National Academy of Design, the youngest man ever to achieve that distinction. In 1910 he became a teacher at the Art Students' League in New York and later taught at the Chicago Art Institute. In 1916 Bellows began experimenting in lithography; in this field he won an enviable position. His works have been exhibited in Berlin, Paris, London and Buenos Aires. The Metropolitan Museum, New York, in 1925 held a notable memorial exhibition of Bellows's paintings and lithographs. The artist died in New York City, Jan. 8, 1925.

**BELLUNO**, a city of Italy, capital of the province of the same name, situated in the Alps, on the Piave River. The city has frequently suffered from earthquakes. The cathedral was begun in the 16th century and decorated in part with remains of older buildings, while the fine campanile was started in 1702 and completed in 1743. Also noteworthy are the Gothic St. Stephen's Church, St. Peter's, the Prefettura on a large square, the Monte de Pietà and the museum. The city was the birthplace of Gregory XVI. The ancient *Bellunum*, Belluno was in medieval times a Lombard duchy, then a Frankish county, which was conferred by the Italian Carolingians on the bishops. In the 12th century it was a free city and a member of the Lombard League of cities. In 1420 it yielded to Venice. During the World War the city fell into the hands of German and Austrian troops in 1917. The chief manufactures are textiles, and there is a brisk trade in lumber, wines and fruits. Pop. 1931, 25,425.

**BELLWORT** (*Uvularia*), a group of low woodland perennials of the lily family found in eastern North America, blooming from April to June. The smooth stems, 6 to 20 in. high, bear perfoliate leaves and yellowish, drooping, usually solitary flowers. The large-flowered bellwort (*U. grandiflora*), with leaves somewhat hairy below, has six-parted, narrowly bell-shaped flowers, about 2 in. long.

**BELMONT, AUGUST** (1816-90), founder of a family of American financiers, was born at Alzei,

Rhenish Prussia, Dec. 8, 1816. He settled in New York in 1837 where he acted as American representative of the banking family of Rothschilds. From 1855-58 he was the American minister resident at The Hague. He died in New York, Nov. 24, 1890. Perry Belmont, his son, was born in New York City, Dec. 28, 1851. He served as U.S. Representative, 1881-89, and as Minister to Spain in 1889. Another son, August Belmont (1853-1924), was born in New York, February 18, 1853. He was associated with the financing and building of the first New York subway system. He died at New York City Dec. 10, 1924.

**BELMONT**, a town in Middlesex Co., eastern Massachusetts, a residential suburb situated 6 mi. northwest of Boston. It is served by the Boston and Maine Railroad and Boston Elevated St. Ry. Co. The town was incorporated in 1859, formed by combining sections of Watertown, Waltham and West Cambridge. In 1929 the retail trade of Belmont amounted to \$5,131,259. The McLean hospital is situated in a section of the town called Waverley. Pop. 1920, 10,749; 1930, 21,707.

**BELOIT**, a city in Rock Co., on the southern boundary of Wisconsin, situated on the Rock River, 70 mi. southwest of Milwaukee. Bus lines and two railroads serve the city. Legion Civic Field, an airport, is near by. Live stock, grain, potatoes and tobacco are raised in this region. Beloit has various manufactures, including wood-working machinery, shoes and refrigerators. In 1929 production reached an approximate total of \$28,000,000; the retail trade amounted to \$14,168,526. It is the seat of Beloit College, the oldest college in the state, founded in 1846. Coal, gas and oil are found in the vicinity. New England settlers came here in 1845; the city was chartered in 1856. Pop. 1920, 21,284; 1930, 23,611.

**BELOIT COLLEGE**, a coeducational, non-sectarian institution at Beloit, Wis., founded in 1846 through the efforts of the Congregational and Presbyterian churches to meet educational needs in that part of the Northwest Territory opened to settlement by the Black Hawk War. Women were admitted in 1896. The college has productive funds of \$2,772,000. Logan Museum in Memorial Hall contains the Logan Archaeological Collection and Department of Anthropology. There are 88,000 volumes in the library. The student enrollment in 1931-32 was 537, and the faculty of 48 was headed by Pres. Irving Maurer.

**BELSHAZZAR**, according to the Book of Daniel, was the last king of Babylon, falling before the Persians in 538 B.C. There is no historical authority for this, however, and some Orientalists have concluded that Belshazzar, or properly Bel-Sar-Uzur, was a son of Nabonnedus, presumably the last king. Others have identified him with one of Nabonnedus's generals.

**BELT**. See **BELTING**; **MATERIAL HANDLING**; **PRODUCTION**, **INTERCHANGEABLE**.

**BELTING**, one of the earliest methods of transmitting power. Belts are usually of cowhide, made in single, double and, for heavy work, even more "plies,"

or layers, cemented together. Until recently belting was formed by hand, but machines now produce a better and more uniform product. The thicker the belt, the less pliable it is and the larger the pulleys required to secure good results. As the transmission of power is accomplished entirely by the friction between belt and pulley, there must always be some slipping. Belts are also made of fabric impregnated with rubber or similar substances, and a type made of sheet rubber is used in special applications. One of these compounds is known as *balata*.

Leather belts are also made round, and are either solid or twisted in the larger sizes. Round belts are usually run in U-shaped grooves and pull more than might be expected. Other belts are made V-shape, sometimes with projections, or cogs, on the narrow edge, to assist in gripping the V groove in the pulley. Ropes of manila or similar material are also used. European rope drives employ a number of individual, endless ropes lying side by side; in America a continuous rope was formerly used with an idler pulley for taking up the slack, but this type has practically disappeared. See **CHAINS**, **POWER TRANSMISSION**, **MECHANICAL**.

F. H. C.

**BELUGA** (*Delphinapterus leucas*), a cetacean, characterized by its rounded head and light color, called also the white WHALE. Like the NARWHAL, it has a very flexible neck, due to the length and complete freedom of the cervical vertebrae. This unusual mobility of the neck enables the beluga to capture the large, active fish on which it feeds. It has from 8 to 10 pairs of teeth in each jaw; a narrow, depressed skull; broad, short flippers, and a low ridge in place of the dorsal fin. The beluga is a native of the Arctic seas, extending in the western Atlantic as far south as the St. Lawrence River.

**BELUS**. 1. In Greek mythology, a son of POSEIDON; b. father of Cepheus whose daughter was ANDROMEDA; c. father of Dido. 2. Chief god of the Babylonians and Assyrians; known as Bel.

**BELVIDERE**, a city in northern Illinois, the county seat of Boone Co., on the Kishwaukee River, 75 mi. northwest of Chicago. Bus and truck lines and the Chicago and Northwestern Railroad serve the city, which is a shipping point for grain and milk going to the Chicago market. Belvidere is an important industrial center, manufacturing sewing machines, hardware, clothing, gloves, scales, toys, washing machines, ironing machines and other products. The city was founded in 1836 and incorporated in 1881. Pop. 1920, 7,804; 1930, 8,123.

**BEMBO, PIETRO** (1470-1547), Italian scholar and cardinal, was born at Venice, May 20, 1470. He edited the poems of Petrarch and the *Terze rime* of Dante. In 1512 Bembo became secretary to Pope Leo X, and in 1539 Paul III made him a cardinal. He was the author of poems, epistles and a history of Venice, all noted for their classic purity of style. Bembo died at Rome, Jan. 18, 1547.

**BEMIDJI**, a city in northwestern Minnesota, the county seat of Beltrami Co., situated about 180 mi.

northwest of Duluth, on Lake Bemidji and Lake Irving, through which the Mississippi River flows. Four railroads serve the city. In the rural districts farming and dairying are superseding timber-cutting in industrial importance. Bemidji has sawmills and wood-working mills. Vast forests and many lakes surround the city. About 25 mi. southwest is Itasca State Park, including Lake Itasca, where the Mississippi River rises. The region has summer resorts and good hunting grounds. Bemidji was founded in 1892 and became a city in 1905. Formerly it was an important trade center for the lumber industry. The city is the seat of a State Teachers College. Pop. 1920, 7,086; 1930, 7,202.

**BEMLEA, LAKE.** See BANGWEOLO, LAKE.

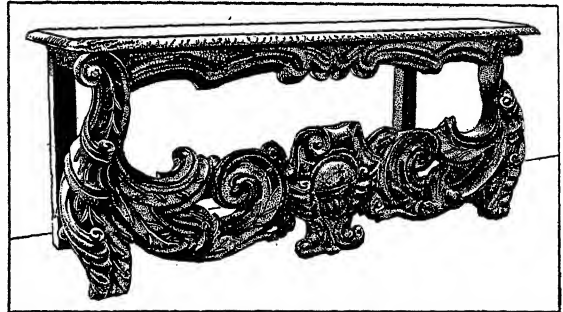
**BÉMONT, CHARLES** (1848- ), French historian, was born in Paris, Nov. 16, 1848. As director of the *Ecole des hautes études* (Sorbonne), and editor-in-chief of the *Revue historique*, Bémont has had a very great influence upon the development of historical studies in France during the past 45 years. His doctoral dissertation, *Simon de Montfort, comte de Leicester*, (1884), of which a new revised English edition was published in 1930, is still the authoritative life of de Montfort. Among his most notable historical works are the following: *De la Condamnation de Jean sans-terre*, (1884); *Rôles gascons*, (1896-1906); *Chartes des libertés anglaises*, (1892); *Recueil d'actes relatifs à l'administration anglaise en Guyenne au XVII<sup>e</sup> siècle*, (1914); *Chronique latine sur le premier divorce de Henri VIII*, (1917); and the text book, *Histoire de l'Europe de 395 à 1270*, written in collaboration with G. Monod.

**BENARES**, a sacred city of the Hindus in India. It stands on the north bank of the River Ganges and presents an imposing frontage of Oriental buildings. Benares reaches into the mists of antiquity to a reputed founder, Kas Raja, about 1200 B.C. Since then it has suffered from the furious visitations of such Islamic fanatics as Mohammed of Ghor and the Mogul Emperor Aurangzeb. Consequently few of its important buildings date further back than the 17th century. Of its almost countless temples the Golden Temple dedicated to Siva is regarded as the most beautiful. That to Kali, goddess of bloodshed, is also called the Monkey Temple since the hundreds of sacred monkeys who reside in the court have free access to the shrine. The sacrifice of live animals to Kali is still practiced, and but a few years ago a human being was offered, contrary to Government edict. Thousands of pilgrims, from all parts of India, Burma and Tibet gather daily on the river front to wash away their sins by bathing in the Ganges, and to drink some of its water so as to ensure their future life. Pop. 1921, 198,447; 1931, 205,509.

**BENAVENTE Y MARTÍNEZ, JACINTO** (1866- ), Spanish playwright, was born at Madrid in 1866. His first plays, notably *The Banquet of Two Beasts*, 1898, *The Evil Doers of Good*, 1905, and *The Bonds of Interest*, 1907, mark the start of modern Spanish drama, as opposed to the false melo-

drama of the 19th century. His effective use of satire in dramatic expression was continued in later works, including *Brute Force*, 1908. Benavente y Martínez's collected plays were translated into English in 1917. He won the Nobel Prize for literature in 1922.

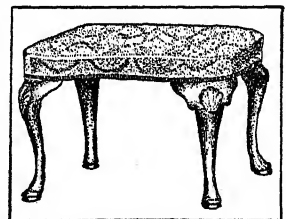
**BENCH**, a long seat for several persons, with or without a back, usually made of wood, sometimes of stone. It differs from the **SETTLE** in not having arms. The bench developed from the **CHEST**, and the earliest examples, and many later ones, had a locker under the



COURTESY M. M. OF ART

WALNUT FLEMISH BENCH OF THE 17TH CENTURY

seat. Some were movable, some attached to the wall, and in the Middle Ages a bench was often attached to the foot of a bed "for conversation." At first they had solid supports in front and back and at the ends, but later these were reduced to mere legs. Often, like the chest, a bench was used to sleep on; Shakespeare speaks of "sleeping upon benches after noon." Benches, which formed the commonest seat in the medieval hall, were frequently decorated in the Middle Ages with elaborate carvings of Gothic or Renaissance design, and rendered more attractive by bright embroidered drapery and cushions; for dignitaries they were further embellished with imposing canopies.



COURTESY JOHN WIDDICOMBS CO.

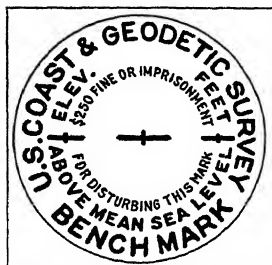
BENCH, QUEEN ANNE PERIOD

**BENCH**, in placer mining, the gravel or sand remnant of the bed of an old stream, which has escaped subsequent erosion and may now be many feet above the present stream level. Occasionally gold, platinum or other valuable ores are found in these deposits, which may be placer mined, and are then known as placer benches. See also **PLACERS**; **MINING**, **PLACER**.

**BENCH MARK**, a point used as a reference basis for elevations. The chief requirements are that its elevation shall not change, and that it shall be determined with such accuracy as is necessary for the purpose of the survey in which it is established. It should be accessible and readily identified. Artificial bench marks, such as are used by government surveys, consist of concrete posts set below frost with bronze markers



in the top, or iron pipes set deep into the ground, the bench mark itself being inside the pipe and below the surface so as to be well protected. Many objects, such as tops of hydrants, underpinning of buildings, stone steps, coping stones of retaining walls, or elevated points on exposed ledges, are used as bench marks.



COURTESY U.S. COAST AND GEODETIC SURVEY

BENCH MARK USED BY U.S. COAST AND GEODETIC SURVEY

**BENCH WARRANT**, a warrant issued by the court itself or by a judge of a superior court sitting in court, for arrest of a person indicted or to be held for contempt, or of a witness, who does not obey a subpoena. Used in distinction

from a warrant issued by a magistrate.

**BEND**, a city in central Oregon, the county seat of Deschutes Co., situated on the Deschutes River, east of the Cascade Mountains, 199 mi. southeast of Portland. Bus lines and two railroads serve the city, which is a commercial and transportation center for a timber-cutting region. The countryside produces alfalfa, potatoes, clover seed and live stock. The chief local industry is lumber milling. Bend is surrounded by beautiful country, having mountains on the west, many lakes and lava and ice caves, one of which formerly supplied the city with ice. Crater National Park lies 112 mi. to the southwest. Bend was founded in 1899; incorporated in 1904. Pop. 1920, 5,415; 1930, 8,848.

**BENDA, JULIEN** (1868- ), French novelist and essayist, was born in Paris, Dec. 26, 1868. He wrote articles for the French periodicals without much recognition, but in 1912 established his reputation with a novel, *L'Ordination*. As a thinker Benda is opposed to the Bergsonian philosophy. His best known work, *Trahison des Clercs*, 1927, makes a sweeping indictment of intelligence enlisted in the service of political passion.

**BEN DAY PROCESS.** See PHOTO-ENGRAVING.

**BENDER.** See TIGHINA.

**BENDIGO**, originally known as Sandhurst, a city of Victoria, Australia, northwest of Melbourne, with which it is connected by rail. The town attracted many people in 1851 when gold was discovered in the vicinity. Bendigo is now the see of a Catholic bishop and an important mining and industrial center. There are large breweries, pottery and foundry works, tanneries, railway shops and other industrial establishments. Fruits and vegetables are grown, and there are extensive vineyards. Est. pop. 1929, 33,700.

**BENEDICITE**, the canticle *Benedicite omnia opera Domini, Domino*. "All ye works of the Lord, bless ye the Lord," also called the Song of the Three Children, which Shadrach, Meshach and Abednego sang when they were unharmed after having been cast into the fiery furnace for refusing to worship a golden image Nebuchadnezzar had set up.

**BENEDICT**, an ecclesiastical name, meaning blessed, of which Benet, however spelled, is an abbreviation. It has been borne by saints, churches, religious orders and 15 popes. Certain of these popes may be specially mentioned, among them Benedict VI, who lived in the 10th century when the whole Empire was riotous and defiant of moral restraints. Elections to the pontificate, therefore, were hotly disputed (see BERNARD OF CLAIRVAUX). In 972 the influence of the Emperor Otho II elevated Pope Benedict VI. But there were two sisters, Marozia and Theodora, wealthy and depraved, who aroused rebellion. (See JOAN.) By the order of Crescentius, the son of Theodora, the new Pope was thrown into the Castle of St. Angelo and strangled. The deacon Franco was installed in the chair of St. Peter as Boniface VII, but on the arrival of Count Sicco, the imperial envoy, he fled with certain papal treasures to Constantinople, and another Pope Benedict VII took his place. In 983 Benedict VII was succeeded by John XIV. But when Otho II, the new Pope's protector, died in Rome, Boniface VII who had never surrendered his rights returned from Constantinople and overcame his rival who, like Benedict VI, ended his days, possibly by starvation, in the grim bastille of St. Angelo. In July, 985, Boniface himself expired, doubtless by violence. His body, naked and covered with wounds, was flung before the statue of Marcus Aurelius, then at the Lateran. He received Christian burial but is denounced by Catholic opinion as an antipope.

Benedict IX was the son of Alberic, Count of Tusculum, and the nephew of his immediate predecessors Benedict VIII and John XIX. He reached the pontificate, according to some accounts, at the early age of 14 (more likely 19) years. His life was dissolute and in 1044 a Roman faction installed John, bishop of Sabina, as antipope Sylvester III. Within a year Benedict had expelled the intruder but, apparently anxious to marry, he sold his office to John Gratian who became Pope Gregory VI in 1045. Faithless to his bond, Benedict attacked Gregory. At this fresh trouble the Emperor Henry III, rejecting Sylvester, Gregory and Benedict himself, installed Pope Clement II. In 1047 the new Pope died, and Benedict asserted himself a third time. He was expelled, however, and Damasus II was installed in 1048. There is a tradition that Benedict finally resigned the Pontificate and died, a penitent, at the Abbey of Grottaferrata.

The pontificate of Benedict XI is best considered as a sequel to the struggles of Boniface VIII, while Benedict XII was one of the popes at Avignon to which, for understandable reasons, the papacy had been removed. In 1378 Gregory XI died. A majority of the Cardinals was French, but the populace of Rome demanded an Italian pope, and the Neapolitan Urban VI was elected. The harshness of the new Pope drove the Cardinals to retire from the city and annul the election, afterwards choosing a second Pope, Clement VII. In this manner there arose a

schism, not theological nor ecclesiastical but definitely administrative. The Roman Conclave elected Boniface IX, Innocent VII and Gregory XII successively to follow Urban VI. In 1394 Clement died and the Cardinals at Avignon chose Peter de Luna, a learned and pious noble of Aragon, to be Pope Benedict XIII. A condition of Gregory's election was that he should retire from his pontificate provided that Benedict also retired, so healing the schism; and at Marseilles the rivals agreed to call a Council to meet in September, 1408, at Savona. But the opposition of King Ladislas of Naples prevented the settlement, and when Gregory, contrary to his promise, created more Cardinals, he was deserted by his previous Cardinals. These, joining their colleagues at Avignon, summoned the Council of Pisa, which in 1409 deposed both Popes, electing Alexander V who was succeeded by John XXIII. The rivals resisted this judgment. But Gregory, exiled from his stronghold of influence at Naples (1411), gave his resignation to the Council of Constance in 1415, dying two years later. Benedict, however, took refuge in an inaccessible fortress at Peñíscola on the seacoast, where he clung to his vanishing pontificate, even creating four new Cardinals to carry on the schism. The Council of Constance denounced him as a perjurer, schismatic and heretic in 1417. *See* SCHISM, GREAT.

No further pope adopted the name Benedict until 1724, when Piero Francesco Orsini at his election took the name with the numeral XIII, so expunging the earlier 13th Benedict from the roll of pontiffs. Aged and infirm, he pleaded with the Conclave not to lay the burden upon him, and while personally venerated, he was ill-served by his friend, Cardinal Nicolo Coscia, who after his death was opposed by the Roman people and sentenced to 10 years' imprisonment for peculation.

In 1740 the Conclave, called to decide on a pope, sat for six months. "If you wish to elect a saint, choose Gotti; a statesman, Aldobrandini; an honest man, elect me," so spoke Cardinal Lambertini who as BENEDICT XIV left behind him a reputation for great learning.

Benedict XV belonged to the 20th century. Giacomo della Chiesa was born at Pegli in Genoa in 1854. An aristocrat, he was trained in the Accademia dei Nobili Ecclesiastici, so qualifying for diplomacy and becoming private secretary to Cardinal Rampolla. In 1907 he became Archbishop of Bologna and in 1914 received the cardinal's hat. At the outbreak of war he delivered an impressive address on the duty of the Church to remain neutral, and when Pius X died, Chiesa was elected Pope after 10 scrutinies of votes. Immediately after his coronation he issued an encyclical appealing for peace, repeating the appeal at Christmas and on the first anniversary of the outbreak of war in July, 1915. He rejoiced in the capture of Jerusalem by Lord Allenby but on two occasions condemned the Balfour Note, with its pledge to the Zionists. By an order permitting Catholic sovereigns to visit the King of Italy, Benedict prepared

the way for the subsequent settlement of the Roman question by his successor, Pius XI. At Benedict's accession 20 nations were represented at the Vatican. When he died in 1922, the number had been increased to 31. France and Britain were among the countries with whom diplomatic relations had been established. Frail in appearance and pale of countenance, Benedict displayed great will-power and left a mark on history.

**BENEDICT XIV** (1675-1758), Pope from 1740 until his death on May 3, 1758. He was born Mar. 31, 1675 in Bologna. After an extensive course of study in Rome he returned to become Cardinal in 1726 and Archbishop of Bologna in 1731. He lived an upright life, was tolerant and mild and established friendly relations with the secular powers, even with the Protestant rulers. He attempted to lessen the influence of the Jesuits, abolished a number of the church holidays, aided trade and industry, founded scientific academies in Rome, beautified the city with works of art, had the best works of foreign writers translated and had a list of Vatican manuscripts printed, the number of which he increased to 3,300. He was himself learned in science and a patron of the arts, and throughout his life was more scholar than ecclesiastic, and author of many valuable treatises on religion.

**BENEDICT, HARRY YANDELL** (1869- ), American educator, was born at Louisville, Ky., Nov. 14, 1869. He taught in the University of Virginia for a time and acted as dean of the College of Arts and Sciences, Vanderbilt University, 1911-27. In 1927 he became president of the University of Texas.

**BENEDICT COLLEGE**, at Columbia, S.C., a co-educational institution for Negroes, founded in 1871 by the American Baptist Home Missionary Society under the name of Benedict Institute. The present title was assumed when the institution was chartered as a college in 1894. The college maintains elementary, preparatory, collegiate and theological departments. Students assist in the care of the campus and buildings. The library contains 8,240 volumes. In 1930 there were 136 students and a faculty of 25 headed by Pres. J. J. Starke.

**BENEDICTINES**, the "black monks" who follow the Rule composed c. 530 by St. Benedict of Nursia, the father of Western monachism. There is no reason to suppose that Benedict designed his Rule, which he wrote probably at the abbey of Monte Cassino, near Rome, for the use of monasteries other than those which he founded, or that he intended to establish an Order in the modern sense of the word; yet so widely was his Rule adopted that in the time of Charlemagne it was thought that monk and Benedictine were interchangeable terms. For centuries each Benedictine monastery was an autonomous and autocephalous community; then the greater abbeys established dependent houses, and this practice, together with the reforms in the 11th and 12th centuries led to the establishment of congregations, each including a certain number of monasteries, which became the

characteristic form of Benedictine organization. There has never been among the black monks anything approaching the highly-centralized organization of younger religious Orders. A corollary to monastic autonomy is the vow of stability included in St. Benedict's Rule: the monk makes his profession not to an Order but to the particular monastery of which he becomes and remains a member.

The contributions made by the black monks to the medieval Church were almost incalculable; they spread throughout western Europe, and the conversion of the English and other Teutonic peoples was mainly due to them. (*See MONASTICISM.*) The Protestant Revolution was accompanied by the dissolution of the monasteries wherever the papal jurisdiction was abolished; in Catholic countries monasticism so decayed that in the early 19th century there were not more than 50 Benedictine houses in all. Then came a revival, and to-day the Benedictines, adapting themselves to the demands of the present, are flourishing and active as preachers and educators in a number of countries.

Convents of Benedictine nuns were founded almost simultaneously with the monasteries, and to-day they are also widely engaged in educational work.

A. H. S.

**BENEDICTION**, a liturgical term derived from Latin and signifying a word of good will. In the Catholic Church the devotion called Benediction takes place either in the afternoon or evening, according to a ritual which varies in different countries. Amid lights and incense the Sacrament is uplifted in a monstrance which permits the Host to be seen by the congregation, and hymns are sung. More generally, the Benediction is the form of blessing with which, among all Christian churches, public worship is brought to a conclusion.

**BENEDICT OF NURSIA, ST.** (c. 480-543), saint and founder of monasticism in Western Christendom. The son of a Roman noble, he was born at Nursia about the year 480, and it may be that his sister, Scholastica, was his twin. At an early age, some say 14 years, more probably 19, he realized his vocation and proceeded with his old nurse to Rome where he fell in love with a lady whose personality infatuated him. Surrounded by the chaos of a turbulent Europe, he retired to Enfide, identified as Affile, where a miracle was reported. The nurse let fall a wheat-sifter which broke but was made whole again by the young Benedict. Disliking the notoriety which assailed him, Benedict fled to Subiaco and, crossing the Anio, found himself in the wild ravine overlooked by the majestic ruins of Nero's villa. Here he met a monk, Romanus, who gave him a hair shirt and habit of skin. Benedict lived for three years in a scarcely accessible cave, overlooking the gorge with its waterfall. Above stood the monastery to which Romanus belonged, and when Benedict heard the tinkle of a bell, he knew that his friend had lowered a loaf, saved from his own meagre rations. Afflicted by visions of the lady he loved, he would strip him-

self naked and throw his body into thickets of thorns, from which asceticism is derived the representation of a rose bush that accompanies many pictures of this saint. In due course the monastery elected him abbot, but the monks rebelled against the austerity of his rule. When, however, they tried to poison him, he made the sign of the cross over the vessel, which split like a stone and fell to the ground. Benedict proceeded to found 12 monasteries each with 12 monks and an abbot, himself presiding over these societies. But the jealousies of other monks drove him to MONTÈ CASSINO where he established the great monastery that perpetuates his name. He died there in 543. Benedict is frequently depicted with a finger at his lips, enjoining silence. A broken goblet and a scourge for discipline are among his symbols.

The rule of St. Benedict, as a way of life leading to religious perfection through the practice of humility, prayer and obedience, has governed a vast network of monastic institutions. Benedict was himself emphatically a layman, appealing to laymen, who thronged to him as to a refuge from the world around them. The Benedictines have always been devoted to the gospel of labor and learning and to religion expressed in social terms. In 1931 there were 155 Benedictine monasteries, 5,940 monks, and unattached to the federation an additional 142 monasteries with 5,347 religious. There were 387 convents for nuns and 10,722 religious within them. In the United States there were 34 convents, all organized within living memory, and containing 2,000 nuns.

**BENEDICTUS**, the name of the canticle of Zacharias, father of John the Baptist, beginning, Blessed be the Lord God of Israel, for He hath visited and redeemed His people. It is one of the few hymns of the church which is recited daily throughout the world. *See MAGNIFICAT.*

**BENEFICE**, a term meaning: (1) a clerical office, and (2) a feudal holding. The two meanings are not, in all probability, unrelated in origin.

(1) A benefice is an ecclesiastical position, with or without the care of souls, the holder of which enjoys permanent tenure and the use of the emoluments, or revenues, attached to the office. Canonries, rectorships, vicarages, and what are known in England as permanent curacies are rated as benefices, so also are some chaplaincies; but curates and other assistant clergy are not beneficed. An abuse not uncommon in the medieval Church was the conferring of benefices on persons, sometimes mere youths, who could not perform the duties of their office. The claim advanced by some popes from the 13th century onward to brush aside the legal rights of patrons and electors and to appoint by papal provision their own candidates to benefices evoked vigorous protests.

(2) In the feudal system the *beneficium* (benefice), or, as it was more usually termed, the *feudum* or fief, was land held in hereditary return for honorable service; and it was about the *beneficium* that the whole feudal structure developed. The personal relationship of lord and vassal was inextricably entan-

gled in the proprietary relationship, the tenure and usufruct of the land. Except in Normandy, England, and the Latin Kingdom of Jerusalem, there were great stretches of alodial land, i.e., land held in fee simple; but in feudal theory all land was held of someone else, in one or another form of feudal tenure. With the introduction of subinfeudation, it became possible for the same fief to be held by several persons and by more than one form of tenure; the ownership of the fief being divided, so to speak, between the proprietor and the possessor. Even kingdoms were occasionally held as fiefs; so King John became the vassal of Innocent III and held the crown of England as a fief from the pope, and John Baliol held the Scots crown as a fief of Edward I of England.

A. H. S.

**BENEFIT OF CLERGY.** The provision of English criminal law by which members of the clergy were exempt from the jurisdiction of secular courts. Not only those in holy orders but others were included, until every man who could read was rated as a clerk. Since church courts could impose no penalty involving loss of life or the shedding of blood, the right to benefit of clergy was highly prized. In the course of the 16th century restrictions were placed on the use of the privilege by classing some felonies as unclergyable and by introducing the provision that persons who committed such crimes should be without benefit of clergy. The system applied to men only until in 1622 equivalent privileges were given to women. After being long obsolete, benefit of clergy was abolished in 1827.

**BENEKE, FREDERICK EDUARD** (1798-1856), German psychologist and professor of philosophy, was born at Berlin, Feb. 17, 1798. He studied philosophy at Halle and Berlin, later succeeding GEORG HEGEL as professor of philosophy. Beneke's system of psychology is highly regarded by German educationists. His chief works are *Pragmatic Psychology*, *New Psychology* and *Psychological Sketches*. He died in June 1856.

**BENĚŠ, EDWARD** (1884- ), Czechoslovak statesman, born on May 28, 1884 at Kozlan, Czechoslovakia. He studied at the University of Prague where he became professor of political economy in 1908. At the outbreak of the World War he went to France where he became very active in the cause of Czech nationality, taking over the editorship of the paper, "La Nation Tcheque." With the establishment of Czechoslovak independence, he was made Foreign Minister in November, 1918, a position he filled with extraordinary ability and insight for many years. An ardent champion of the peace treaties, he was also a principal author of the Little Entente, working in close harmony with France in international matters.

**BENÉT, WILLIAM ROSE** (1886- ), American poet and critic, was born at Ft. Hamilton, New York Harbor, Feb. 2, 1886. He was educated at Sheffield Scientific School, Yale, and for several years was a free lance writer of poetry. He served on the edi-

torial staff of *Century Magazine*, the *New York Evening Post* and *The Saturday Review of Literature*. In 1923 he married ELINOR WYLLIE. Benét's collected poems and other writings include *Moons of Grandeur*, 1920, *The First Person Singular*, 1922, and *Man Possessed*, 1927.

**BENEVENTO**, a city of south central Italy, capital of the province of the same name, beautifully situated above the Calore and Sabato rivers, with a background of mountains. The city is rich in antique buildings, among them the famous triumphal Arch of Trajan erected 114 A.D. It has ancient city walls, the cloister of S. Sofia, founded 760, a Norman-Romanesque cathedral of the 12th century with fine art treasures, and other interesting buildings both religious and secular. The inhabitants are engaged chiefly in artistic handicraft and trade in agricultural products from the fertile surroundings. The ancient *Maleventum*, in its heyday Benevento was the center of Lombard rule, which lasted until Norman times. Pope Leo IX made it a part of the PAPAL STATES. In the Battle of Benevento between Manfred and Charles of Anjou, the former lost his life as well as his throne. After his election to the papacy Pope ALEXANDER VI conferred Benevento as a duchy on his eldest son, Juan Borgia. It became Neopolitan in 1798, Napoleon gave it in 1806 as a titular principality to Talleyrand and from 1815 to 1860 it was Papal once more. Pop. 1931, 36,920.

**BENGAL**, a Presidency of India, stretching from the Himalayas to the Bay of Bengal, with Assam and Burma on the east, and Bihar and Orissa on the west. It has an area of 82,277 sq. mi. Nearly the whole of the country is a fertile plain watered by the Ganges and the Brahmaputra rivers. In addition to rice and other grains, which form with fruit the principal food of the inhabitants, tea, indigo, opium, sugar cane and cotton are grown. In ancient days Bihar was the center of influence and Bengal proper was under Hindu princes until the region was captured by the Mohammedans at the end of the 12th century. In 1539 Afghan chiefs were in power. The Moguls ruled at the close of the 16th century. The greater part of Bengal was ceded by the Nabob to the East India Company in 1765; and in 1858 it became British territory. It was partitioned into two divisions in 1905, and in 1912 the partition was reversed, and BIHAR and ORISSA formed a new province. (See INDIA, HISTORY OF.) The inhabitants, Mohammedans and Hindus, speak the Bengali language. Pop. 1921, 47,592,462, including two Indian states; 1931, 49,997,376.

**BENGAL, BAY OF**, a large bay between Burma and India in the northern part of the Indian Ocean, on or near which are located Madras, Calcutta and Rangoon. Among the many rivers which flow into the bay are the Ganges, Brahmaputra and Irrawaddy.

**BEN-HUR**, the title-character of a historical novel by the American soldier and author, LEW WALLACE; published 1880. This very popular work about Judea in the days of Christ is an exciting history of enmity

and struggle between Judah Ben-Hur and the friend of his childhood, Messalla. The two most spectacular incidents are a sea fight and the culminating chariot race.

**BENICIA**, a port town in Solano Co., northwest central California. It is situated on the Strait of Carquinez, 30 mi. northeast of San Francisco, and is served by steamship lines and the Southern Pacific Railroad. The town has commercial fisheries, and manufactures of tractors, motors and fruit sprays. A United States arsenal and barracks are situated here. Benicia was founded by the Spaniards in 1848, and at one time was the rival of San Francisco. For a short time, 1853 to 1854, it was the capital of California. The city was chartered in 1861. Pop. 1920, 2,693; 1930, 2,913.

**BENJAMIN**, a Hebrew patriarch and youngest son of JACOB by his favorite wife, Rachel. Dying in childbirth, his mother called him Ben-oni (son of my sorrow); but his father changed it to Benjamin (son of my right hand). Rachel's elder son was JOSEPH who, as an exile in Egypt, yearned for Benjamin as his full brother. The name, Benjamin, was applied to one of the 12 tribes and it was to Benjamin that SAUL the King and Saul, afterwards called Paul the apostle (see PAUL, ST.), belonged. The territory of the tribe was small and rugged, lying immediately north of Judah, to which kingdom Benjamin adhered when the 10 tribes of Israel seceded (I Kings 12). Unlike their ancestor, the Benjamites were devoted to war. They were skilled especially in archery and used the sling. Retribution that nearly obliterated the Benjamites is described in Judges 19-21.

**BENJAMIN, JUDAH PHILIP** (1811-84), American statesman and lawyer, was born at St. Croix, West Indies, in 1811. When he was a few years old, his parents brought him to the United States, where he was educated, and he finally settled in New Orleans, La. Here he was admitted to the bar, and rapidly rose to the front, and became deeply interested in politics as well. Benjamin was elected to the United States Senate in 1852, and reelected six years later. He declined a seat on the United States Supreme Court bench, tendered to him by President Pierce. At this time he was recognized as one of the ablest lawyers and orators in the country.

Benjamin sided with the South on the slavery and secession issues, and resigned his seat in the Senate to accept appointment from President Jefferson Davis as Attorney-General of the Confederacy on Feb. 25, 1861, and Secretary of War thereafter. Although bitterly assailed for supposed failure to conduct the Confederacy's military operations wisely, due largely in fact to lack of ammunition which he concealed, he became Secretary of State in 1862, and retained that post until the Government fell in 1865. He was often characterized as "the brains of the Confederacy." Benjamin fled when the Union cause triumphed and settled in England, where he became before long the acknowledged leader of the British bar. Soon after settling in England, he published his work on *The*

*Law of Sales of Personal Property*, which is still a recognized legal classic. A year before his death, he retired from practice. He has been described as the most distinguished Jew in the annals of American history, though he never actively identified himself with Jewish affairs. Benjamin died in Paris, May 6, 1884. M. J. K.

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**BENNETT, ENOCH ARNOLD** (1867-1931), English novelist and playwright, was born at Hanley, Staffordshire, May 27, 1867. He intended to be a lawyer, but soon abandoned the law to devote himself entirely to writing. He was a prolific contributor to magazines and newspapers, and in 1896 became editor of the magazine *Woman*. With the publication of *The Old Wives' Tale* in 1908 Bennett took his place as an outstanding novelist. He wrote prodigiously, publishing in quick succession the novels, *Clayhanger*, *The Card*, *Hilda Lessways* and *The Matador of the Five Towns*. In 1923 he published *Riceyman Steps*, a novel acclaimed as second only to *The Old Wives' Tale*. With Edward Knoblock he collaborated on a play, *Milestones*, produced in 1913 with considerable success. In the field of the novel he produced little that was worthy after *Riceyman Steps*, with the possible exception of *Imperial Hotel*, 1930. Bennett was a realistic interpreter of modern life, particularly the life of the so-called Five Towns, with a real genius for imparting glamour and interest to the commonplace. He died Mar. 27, 1931 in London.

**BENNETT, JAMES GORDON** (1795-1872), American journalist, was born at Newmills, Scotland, Sept. 1, 1795. He came to America in 1819, and became eventually the owner of several newspapers. He founded the *New York Herald*, May 6, 1835. He died in New York June 1, 1872. He was succeeded by his son, James Gordon Bennett (1841-1918), who sent Sir Henry M. Stanley to Africa in search of the missionary, Dr. David Livingstone.

**BENNETT, RICHARD BEDFORD** (1870- ), Prime Minister of Canada, was born at Hopewell, New Brunswick, July 3, 1870. He was educated in the schools at New Brunswick, later attending Dalhousie University, Halifax, N.S. He was a member of town and municipal councils of Northumberland in 1896, moving to Calgary, Alberta, the following year, and serving in the legislative assembly of North-West Territories from 1898-1905. After being admitted to the bar of New Brunswick, he practiced law, and held many public offices, finally becoming Prime Minister of Canada and Minister of External Affairs and Finance, in 1930.

**BENNETTITES**, the best known genus of the interesting extinct Mesozoic plants commonly called fossil cycads, which recent research has shown bore elaborate bisexual flowers. Numerous magnificent stumps from the Black Hills of Wyoming and South Dakota, shown in the United States Museum and the



Peabody Museum at Yale University, preserve immature leaves, pollen, and seeds containing embryos. The stems are stumpy, sometimes nearly globular. Among their persistent leafbases appear conical rosettes which, as Wieland was the first to show, are unexpanded flowers. Long fernlike stamens recurved about a central seed-bearing column were enclosed in bracts suggesting the petals of a modern flower. From the immense numbers of flowers, as many as 500 on a single stump, it is believed the plant fruited but once, then died down.

**BEN NEVIS**, the loftiest elevation in Great Britain, in the Co. of Inverness, Scotland, situated between 56° N. lat. and 5° W. long. Its height of 4,406 ft. and gigantic mass—its base is more than eight mi. in diameter—are not immediately discernible because the summit is not a peak but a plateau occupying 100 acres. The southern portion of the mountain presents a gentle incline, but on the northeast it falls in a steep precipice from a height of 1,500 feet. The cloud-line is generally at 3,000 ft. A porphyritic compound is the chief rock constituent of the peak. Granite and gneiss are the basis of the lower slopes. Glens and rivers surround Ben Nevis on all sides.

**BENNINGTON**, a village and county seat of Bennington Co., Vt., 38 mi. northeast of Albany, N.Y., on the Walloomsac River. It is served by the Rutland Railroad, bus lines and an emergency airport. Bennington lies in a picturesque farming and orchard region at the foot of the Green Mountains, at a point where main highways of three states intersect. Textile and wood-working industries lead, but knit and woolen goods, paper, furniture, brushes and "kiddie-kars" are also manufactured.

Originally one of the "New Hampshire grants" disputed by New York, the town, named for New Hampshire's governor, Bennington Wentworth, was organized in 1782 and the village incorporated in 1849. Capt. Samuel Robinson built the first log cabin in 1761. As the headquarters of the "Green Mountain Boys," the home of Ethan Allen and Seth Warner, the site of the Battle of Bennington, and other Revolutionary maneuvers, the village is famous. Robert Frost and John Spargo, the writers, lived in Bennington and also William Lloyd Garrison, while he was publishing *The Journal of the Times*. Bennington pottery, valued by collectors, was first produced in 1793 by Capt. John Norton; the industry flourished for a century. Pop. 1920, 7,230; 1930, 7,390.

**BENNINGTON, BATTLE OF**, Aug. 16, 1777, an engagement of the Revolutionary War which resulted in an American victory. To procure supplies and ammunition, and to enlist Loyalists, for the British army in upper New York, Gen. Burgoyne detached Col. Baum with 550 Hessians and 150 Indian allies to take the village of Bennington, Vt. Gen. John Stark mustered about 2,000 militia and attacked the British force. Before a reinforcement of 640 Hessians under Col. Breyman had arrived, Baum's troops were badly defeated. Stark, with an additional force of 500 volunteers under Seth Warner, then turned

upon Breyman's troops and won a second victory. The British loss included 207 killed and 700 captured; the American casualties were 82. At the news of the battle large numbers of Canadians and Indians in Burgoyne's army deserted, and conversely enlistments in the Patriot militia greatly increased.

**BEN NUT**, the name given to the large, three-angled, winged seed of the HORSERADISH-TREE (*Moringa oleifera*), a small tree of the moringa family native to India and planted in mild climates. The seeds, which are borne within a narrow, ribbed, three-valved capsule, sometimes 1½ ft. long, yield ben-oil, sparingly used in the arts, for extracting perfumes and in the lubrication of fine machinery.

**BENSON, ARTHUR CHRISTOPHER** (1862-1925), English writer, was born Apr. 24, 1862. He was educated at Eton and Cambridge, was a master at Eton from 1885 to 1907, and master of Magdalene College, Cambridge, from 1915 to 1925. His writings include critical biographies, poems, essays and novels. Among his many works are *The Life of Archbishop Benson*, *Ruskin*, *The House of Quiet*, *Beside Still Waters*, *Fasti Etonenses*, *Archbishop Laud* and *Memoirs of Arthur Hamilton*. His best known work is *From a College Window*, published 1906. Benson died at Cambridge, June 17, 1925.

**BENSON, FRANK WESTON** (1862- ), American painter and etcher, was born at Salem, Mass., Mar. 24, 1862. He studied at the Boston Museum School and in Paris under Boulanger and Lefebvre. Benson has been awarded numerous medals and other prizes for his work, which includes portraits, landscapes and notable etchings of wild fowl.

**BENT GRASS**, the name commonly applied in America to various species of *Agrostis* comprising several valuable meadow, pasture and lawn grasses. Among the most important are the redtop (*A. palustris*), a leading meadow and pasture grass in the northern states, and the Rhode Island bent (*A. capillaris*), velvet bent (*A. canina*) and carpet bent (*A. stolonifera*), used as lawn grasses.

**BENTHAM, JEREMY** (1748-1832), English writer on ethics and jurisprudence, was born at London, Feb. 15, 1748. He entered Oxford at the age of 12 and prepared for the law but abandoned its practice for its theory. He became a leading critic of legislation and government. Bentham advocated many legal reforms which have since been adopted. He urged that universal suffrage and vote by ballot be adopted, that parliament meet annually and that the representatives be paid. The doctrine of utility pervaded his ethical and political writings. His chief works are *Introduction to the Principles of Morals and Legislation*, *A Fragment on Government*, *Rationale of Judicial Evidence* and *The Constitutional Code*. He died at London, June 6, 1832.

**BENTON, THOMAS HART** (1782-1858), American statesman, was born near Hillsborough, N.C., Mar. 14, 1782. He studied for a short time at the University of North Carolina, but moved to Tennessee where he was admitted to the bar. After

seeing service in the War of 1812, Benton was a newspaper publisher in St. Louis, Mo., and was elected Senator in 1820. He rapidly became the political leader of Missouri. Because he championed a gold and silver currency, he gained the nickname of "Old Bullion." He favored the annexation of Texas in 1845 and was against Calhoun with regard to state rights. In 1851 Benton retired from the Senate, after having lost his seat over the Clay compromise bill, to become a Representative the following year. A candidate in 1856 for Governor of Missouri, he lost the election and in his retirement wrote his *Thirty Years' View*. Benton died at Washington, D.C., in April 1858.

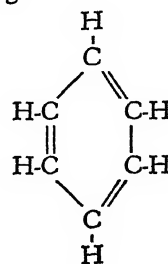
**BENTON**, a city in southern Illinois, the county seat of Franklin Co., situated 90 mi. southeast of St. Louis, Mo., and served by three railroads. Grain, fruit and livestock are raised in this region; the city manufactures explosives, harness and enameled stoves. Benton is surrounded by an important coal mining section. Pop. 1920, 7,201; 1930, 8,219.

**BENTON HARBOR**, a city in Berrien Co., southwestern Michigan, situated on the St. Joseph River,  $1\frac{1}{2}$  mi. east of Lake Michigan, and 1 mi. north of St. Joseph. By means of a canal to the lake the city has steamship service to Chicago and Milwaukee; it is served also by bus and truck lines and three railroads. Benton Harbor manufactures castings, trucks, tractors, boilers, novelties, furniture, machinery and canned goods. In 1929 the value of the manufactures was about \$11,000,000; the retail trade amounted to \$13,278,893. Trade in fruit, grain, lumber and bottled water is also important. Nearby are several mineral springs of medicinal value. Benton Harbor is the home of the House of David. Pop. 1920, 12,233; 1930, 15,434.

**BENTONITE**, called also mineral soap and soap clay, a rock containing mostly the minerals montmorillite or beidellite. It consists essentially of hydrous silicates of aluminium, magnesium and iron. Bentonite is the product of the WEATHERING of volcanic TUFFS or glassy LAVAS, and is cream to olive green in color. Prominent characteristics are its colloidal nature and its ability to absorb water with consequent pronounced swelling, becoming frequently a slippery jelly. Normally it has the appearance of a waxy clay. There are numerous uses for bentonite as a detergent, a filler in paper making, scouring textiles, refining petroleum, de-inking newsprint, a water softener, and a base for drugs and beautifying clays. It is found in extensive beds in many places, being mined in some western states, as Wyoming and California.

**BENZALDEHYDE**, the simplest aromatic ALDEHYDE, is a colorless volatile liquid with a pleasant fragrance of bitter almonds. It occurs in nature as a decomposition product of AMYGDALIN, a constituent of bitter almonds; synthetically it is made from TOLUENE, or benzylchloride; oxidation converts it into BENZOIC ACID. It is popularly known as oil of bitter almonds.

**BENZENE**, a colorless, volatile liquid hydrocarbon ( $C_6H_6$ ) of fundamental importance, industrially as well as scientifically, known also as benzol. It was discovered by Faraday in 1825. It is now largely obtained from coal tar, constituting the bulk of that fraction which distills at about  $80^\circ$  C. When pure, it appears as a colorless, very mobile and volatile liquid which burns with a dark, smoky flame. It has a peculiar "clean" smell, and is a solvent for a large number of organic substances, especially FATS, WAXES, RESINS, and even RUBBER. Scientifically, its importance is derived from the fact that it forms the basis of the enormous class of homocyclic AROMATIC COMPOUNDS. Its molecule contains six atoms each of carbon and hydrogen, and, following the suggestion of Kékulé, it is now generally considered that the six carbon atoms form a hexagon, or closed ring, the benzene nucleus or ring:



to each carbon atom is attached one hydrogen atom, while, in order to satisfy the four valencies of the carbon atom, the ring is supposed to contain alternately single and double bonds, and is thus unsaturated. Benzene can be made synthetically from acetylene,  $C_2H_2$ . Each of the hydrogen atoms may be readily replaced by bromine, an hydroxyl, a nitro-, and amino-, or an aliphatic alkyl group, giving rise to monobromobenzene, PHENOL, NITROBENZENE, ANILINE, or TOLUENE. By continuing the process of adding various such groups, as well as by uniting two or more benzene rings, an almost limitless variety of compounds may be built up, of which benzene is considered as the parent substance. Among these compounds are a large number of synthetic dyes (*see* DYES, SYNTHETIC), many of which are made from benzene or its derivatives. W. J. L.

**BENZIDINE**, a colorless, crystalline aromatic compound, containing two benzene rings and two amino-groups. It is obtained by the reduction of nitrobenzene with azo-benzene as an intermediary compound, and forms the basis of a number of valuable dyestuffs (*see* DYES, SYNTHETIC) such as Congo-red, all of which have the ability to dye without a mordant.

**BENZINE**. *See* PETROLEUM.

**BENZOIC ACID**, a white crystalline substance and the simplest aromatic acid (*see* AROMATIC COMPOUNDS) ( $C_6H_5COOH$ ), occurs in nature in many balsams, gums and resins. Synthetically it is made from TOLUENE, and is used extensively for perfumery, as a base for dyestuffs (*see* DYES, SYNTHETIC), as a

food preservative, and for incense; while medicinally it is applied in some diseases of the skin and the urinary passages, and for inhalations in case of respiratory troubles.

**BENZOIN**, the balsamic resin obtained from *Styrax Benzoïn* known in commerce as Sumatra benzoïn and from other species of *Styrax*, known as Siam benzoïn. It occurs as blocks or lumps of varying sizes or pebble-like tears, having an agreeable odor with an aromatic taste, used as incense. It contains a large amount of BENZOIC ACID. Synthetically benzoïn is a polymerization product of BENZALDEHYDE, possessing the properties of an *alcohol* as well as of a ketone. As a tincture, benzoïn is used chiefly to impart a pleasant odor in ointments and lotions. A compound tincture is used for purposes of inhalation by vaporization in treatment of throat and bronchial inflammations.

**BENZOPHENONE**, the simplest KETONE in the aromatic series, contains two phenyl groups joined to the typical ketone group ( $C=O$ ), its formula being  $C_{12}H_{10}CO$ . It is formed upon heating calcium benzoate. Some of its amino-derivatives are used in the dye industry. See also DYES, SYNTHETIC.

**BENZYL ALCOHOL**, the simplest aromatic ALCOHOL, is a colorless liquid with only a faint odor, and occurs in nature in several balsams and oils. By treatment with nascent hydrogen, it is transformed into TOLUENE, while oxidation produces BENZALDEHYDE, which in turn splits up into BENZOIC ACID and benzyl alcohol again when acted upon by caustic potash.

**BEOWULF**, the oldest long epic in England, composed in Old English probably in the 8th century, and based, it is thought, on poetry of a period before the Anglo-Saxons had left the Continent. An invaluable record of the people and customs of that early day, this is the vigorous history-myth of Beowulf, a prince among the Geats (of south Sweden), whose first adventure is to rid Hrothgar, king of the Danes, of a devastating monster, Grendel. Clangorous and rude in style, moving against a wild and fatalistic background, the narrative comprises five chief episodes: Beowulf's conquest of Grendel; the slaying of Grendel's mother; the return to his native land, where he is king for 50 years; his last fight with a fire-dragon, in slaying which he receives his own death-wound; the hero's funeral rites. The unique manuscript in which *Beowulf* has come down consists of 3,183 lines, and is one of the proudest heritages of the Anglo-Saxon race.

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**BEQUEREL RAYS**. In 1896, Becquerel made a study of URANIUM salts and found that photographic plates in their immediate neighborhood were blackened, despite the fact that they had previously been packed very carefully in a light-tight wrapping. This pointed to a new kind of rays, now called BETA RAYS,

which were capable of passing through bodies opaque to ordinary LIGHT rays. These same rays were also found to have the ability of ionizing a gas, such as the air, and of producing scintillations or minute flashes of light on a chemically prepared luminescent screen (see LUMINESCENCE). Investigation has shown that many of the radioactive elements (see RADIOACTIVITY) spontaneously emit these rays throughout their entire lifetime. See also ALPHA RAYS; GAMMA RAYS.

**BEQUEST**, a gift of personal property in a will. A synonym of LEGACY.

**BÉRANGER, PIERRE JEAN DE** (1780-1857), French song composer, born at Paris, Aug. 19, 1780. He had many distinguished friends including Chateaubriand, Thiers, Michelet, Mignet and Lucien Bonaparte, but preferred to identify himself with the common people. His songs were often tinged with socialistic spirit, a fact which caused his imprisonment on several occasions. He was elected to the Constituent Assembly in 1848. Béranger's most popular songs include *Le Roi d'Yvetot*, *Le Vieux Drapeau*, and *Le Vieux Vagabond*. He died at Paris, July 16, 1857.

**BERAR**, formerly known as the Hyderabad Assigned Districts, and until lately a province of India, forming a commissionership in the Deccan; area 17,767 sq. mi. The region is mainly a broad valley between the Satpura and Ajanta ranges. Cotton is grown on irrigated areas. Coal and manganese are mined. Berar became a part of the Mogul empire in 1687. In 1713 the Nizam of Hyderabad was appointed administrator of the region, and in 1853 he assigned it to the British government in security of arrears due. The province was transferred to the administration of the Central Provinces in 1902. Pop. 1921, 3,075,316; 1931, 3,443,765.

**BERAT**, a town in the southern part of ALBANIA, located about 30 mi. northeast of Valona on the Osum River. It consists of an upper town or citadel, which has no strategic value whatever, and a lower town of numerous mosques. Though populated chiefly by Albanian Moslems, Berat is the seat of a Greek Orthodox bishop and has several Greek churches. In Turkish days Berat was the seat of a pasha. Ibrahim of Berat led a Moslem rebellion against the despot Ali Pasha, but was captured by the latter and locked in the dungeons of the Castle of the Lake at Yannina, where he perished in old age. Austrians and Italians gained possession of Berat at different times during the World War. The distillation of raki, or brandy, is carried on extensively here. The valley surrounding the city has abundant crops of olives and fruit. Pop. 1930, 10,403.

**BERBER**, a language-group of the HAMITO-SEMITIC linguistic family spoken by some 5,000,000 persons in northern Africa from the oasis of Siwah to the Atlantic, and from the Mediterranean to the Niger and Senegal, over a scattered area, partly desert, which it shares with ARABIC. It is divided into dialects of the same grammatical type, differing primarily in the treatment of certain consonants, and is

sometimes written (with the exception of Tuareg) in Arabic script. The following dialects are known: Tuareg, written in a consonantal script called Tifinagh, in the Sahara; Zenaga in Mauritania; Shluh, Beraber and Riffian in Morocco, the region showing the maximum Berber population; in Algeria, especially the dialects of Kabylia and Aures; dialects spoken in small areas in Tunisia, Tripoli and Cyrenaica; and, probably, the extinct GUANCHE. Inscriptions in Ancient Berber (also known as Libyan) are found especially in the old Punic area; they are written in an alphabet akin to Tifinagh, but are as yet only imperfectly interpreted. M. C.

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**BERBERS**, indigenous Hamitic peoples of northern Africa occupying the region south from the Mediterranean to the northern Sahara and west from Egypt to the Atlantic. The Berbers are descendants of the peoples known to the Greeks and Romans as Libyans. They are light-skinned. The typical Berber has black hair and brown or hazel eyes; approximately 10% have fair hair and light eyes, and in the western section of North Africa there are remnants of a people with blonde hair and blue eyes. The origin of these blondes has never been satisfactorily determined. Some authorities, basing their opinions on cephalic measurements, claim that they are either descendants of a Scandinavian people or that Scandinavians and Berbers are descended from a common stock. Egyptian monuments from as early as 1700 B.C. depict Libyans with white skin, blue eyes, and fair beards. Berbers and Arabs took part in the Moorish invasions of Spain in 710 A.D. With the exception of the Tuaregs, who are monarchical, the social organization of the Berbers is essentially democratic, even communistic. Generally speaking they are good craftsmen and do creditable work in textiles and leather. They are skilled agriculturists, and also mine and work metals. Their silver jewelry is distinctive and beautifully designed. Berber pottery is characteristic and shows a striking relationship to that of predynastic Egypt.

**BERCEUSE**, in music, a cradle-song or lullaby, also used as the name of an instrumental composition which suggests a gentle, rocking motion. Chopin's *Berceuse* in D flat for the pianoforte is a celebrated example of this musical form.

**BERCHTOLD, LEOPOLD, COUNT** (1863- ), Austrian diplomat and statesman, born Apr. 18, 1863 at Vienna. He entered the diplomatic service in 1893, at the age of thirty. In 1907 he became Austrian ambassador to St. Petersburg, remaining there till 1911. In Feb. 1912, he was made foreign minister of the Dual Monarchy, holding that important post till Jan. 1915. It was therefore upon Berchtold's shoulders that the heavy responsibility rested of guiding Austria-Hungary into the fateful controversy with Serbia, and ultimately into the World War. It was at Berchtold castle at Buchlau on Sept. 15, 1908, that the famous conference between the Russian for-

eign minister, Isvolsky, and the Austrian minister Aehrenthal took place, which led directly to the annexation of Bosnia and Herzegovina by Austria. In the difficulties over Serbia's ambitions for a port on the Adriatic during the Balkan Wars, he maintained an unyielding attitude toward all attempts at compromise. The same policy characterized his action in the critical days following the assassination of the Archduke Francis Ferdinand. The terms of the Ultimatum to Serbia and the decision as to war or peace in July, 1914, depended to a large degree on Count Berchtold.

**BERDICHEV**, a city in northwestern Ukrainian S.S.R. It is located about 200 mi. southwest of Kiev in southwestern European Russia. Situated among woods and steppes, it is a railroad center and the seat of well-developed leather and sugar industries. Berdichev formerly belonged to Lithuania and was long the property of the Radziwill family, whose palace is now the Soviet hospital. The interesting Barefooted Carmelites monastery dates from 1627. About 65% of the inhabitants are Jewish, with Ukrainians, Russians and Poles comprising the rest. Pop. 1926, 55,613.

**BEREA**, a city in northeastern Ohio, in Cuyahoga Co., situated 12 mi. southwest of Cleveland and served by three railroads. Baldwin-Wallace College is located here. There is a grindstone quarry near Berea and the surrounding region is good farmland. Pop. 1920, 2,959; 1930, 5,697.

**BEREA COLLEGE**, a coeducational institution at Berea, Ky., privately controlled and non-sectarian, was chartered in 1855. It had its beginning in an anti-slavery Union church founded in 1853, out of which grew the village and college of Berea. The college maintains both junior and senior high school departments. Its productive funds in 1931 were \$9,515,215. The library contains 60,000 volumes, including a special collection of mountain material. In 1931-32 there were 585 students in the college and a faculty of 37, headed by Pres. W. J. Hutchins.

**BERGAMO**, a city of Italy, capital of the province of the same name, beautifully situated at the foot of the Alps between the Brembo and Serio rivers. It is a railroad center, with an automobile highway to Milan, is the seat of a bishop and of an art school with a museum. The lower city, formed by several suburbs grown together, has a modern civic center with a city hall and theater. The old city rises picturesquely on a steep hill surrounded by bastions and fine promenades dominated by the citadel. The streets are narrow and crooked but adorned with marvels of medieval architecture, particularly on the Cathedral and Garibaldi squares. The Palazzo della Ragione, now a library, is the oldest of the palaces. The Romanesque basilica of S. Maria Maggiore, built in 1137, the cathedral, the Cappella Colleone, the baptistery and other churches and palaces are also of surpassing beauty. The ancient *Bergamum*, Bergamo joined the Lombard League as a free city, but in the 13th century sided with the Hohenstaufen and in 1264 lost its inde-

pendence, coming under the authority of the Guelphic Milan. From 1296 to 1428 Bergamo was under the rule of the Visconti, from 1428 to 1797 under that of Venice, and from 1815 to 1854 under that of Austria. Pop. 1931, 82,134.

**BERGAMOT**, the name given to a small tree (*Citrus Bergamia*) of the rue family closely related to the common orange. The tree, which is extensively cultivated in Calabria, bears oblong leaves on winged stalks, small, fragrant, white flowers and smooth, pear-shaped, yellowish fruits, 3 to 4 in. in diameter, enclosing an acid pulp and numerous seeds. The thin, aromatic rind yields the essential oil known as oil of bergamot, extensively used in perfumery. Various plants of the mint family are called bergamot as the bergamot mint (*Mentha citrata*) and also various species of *Monarda*, especially *M. fistulosa*, the wild bergamot.

**BERGEN**, a seaport of southwestern Norway, famous as a codfish market. It is a trading-center second only to Oslo, and its fish exports are nearly half those of the entire country. It has an important marine biological station, a fishery museum, and an annual international fish fair. Shipbuilding and barrel and rope-making are among its industries. The town was a headquarters of the HANSEATIC LEAGUE, to whose establishment here, in 1445, its prosperity is traced. OLE BULL and EDVARD GRIEG were natives of Bergen. It is a popular center for tourists. Pop. 1930, 98,303.

**BERGENFIELD**, a borough of Bergen Co., N.J., located 6 mi. northwest of the New Jersey terminus of the George Washington Memorial Bridge and adjoining Dumont, N.J., on the south. It is served by the West Shore and the New York, Ontario and Western railroads and motor bus lines. Bergenfield is strictly a residential suburb. Pop. 1920, 3,667; 1930, 8,816.

**BERGEN-OP-ZOOM**, a city in the province of North Brabant, Holland, at the confluence of the Zoom and the Oosterschelde, located in a marshy district on the Rosendaal-Flushing Railway, was once one of the strongest fortresses in Holland. Bergen has a fine city hall, three churches, barracks, once the castle of the margraves, a harbor, anchovy fishery, and manufactures of pottery and tiles. In 1577 the Spaniards were driven from the city; in 1747 and again in 1795 it fell into the hands of the French. The British besieged it in 1814, but it did not capitulate until the treaty of peace was signed. Pop. 1930, 21,450.

**BERGER, VICTOR L.** (1860-1929), American socialist leader, was born in Nieder Rebbuch, Austria-Hungary, Feb. 28, 1860. He studied at Vienna and Budapest but came to the United States before graduating and settled in Milwaukee. Here he became one of the leading socialists of the Middle West and in his position as editor of the Milwaukee *Leader* exerted a determinative influence upon the founding of the Social-Democratic, afterwards the Socialist Party. He sat as Representative in Congress from 1911 to 1918

when his frank stand against the war led to his expulsion. In 1923 he was allowed to resume his seat. He died at Milwaukee, Wis., Aug. 7, 1929.

**BERGERAC, SAVINIEN CYRANO DE** (1620-55), French author and duelist, was born in Périgord in 1620. It is asserted that he fought more than 1,000 duels, most of them brought about by comment on his exceedingly large nose. He was wounded at the Siege of Arras in 1640 and thenceforth devoted himself to literature and dueling. Bergerac's writings are remarkable for wit and vigor. They include a comedy, *Le Pédant Joué*, from which Corneille and Molière borrowed ideas, and a tragedy, *Agrippine*. He also wrote a *Historie Comique des États et Empires de la Lune et du Soleil*. Critics assert that this work suggested *Micromégas* to Voltaire and parts of GULLIVER'S TRAVELS to Swift. He is the hero of Edmond Rostand's noted play CYRANO DE BERGERAC. Bergerac died in Paris in 1655.

**BERGH, HENRY** (1820-88), American humanitarian, was born at New York City in 1820, and was educated at Columbia University. In 1862 he accepted a diplomatic post at St. Petersburg, Russia, but returned to America two years later. In 1866 he succeeded in incorporating in New York the Society for the Prevention of Cruelty to Animals, an organization which was later to carry on its work in many states and several foreign countries. Bergh also established the Society for the Prevention of Cruelty to Children. The humanitarian died Mar. 12, 1888.

**BERGIUS PROCESS.** For production of oils by coal hydrogenation. See PRESSURE REACTIONS IN INDUSTRIAL CHEMISTRY.

**BERGMAN, HJALMAR** (1883-1931), Swedish novelist and dramatist, was born at Orebro, Sept. 19, 1883. His most characteristic work is found in a series of novels of small-town life in Sweden, *The Testament of His Grace*, *Comedies in Bergslagen*, *Memories of a Dead Man*, etc. His most successful novel is *Markurells i Wadköping*, translated in 1924 as *God's Orchid*, which he later made into a play. Among Bergman's other plays are *Swedenhielms* and *Marionette Plays*. He died at Berlin, Germany, Jan. 1, 1931.

**BERGMANN, CARL** (1821-76), German music composer, was born at Eberslach, Saxony, Feb. 11, 1821. He first became a piano and violoncello virtuoso and later a conductor. In 1848 he went to New York, and during 1850-52 was conductor of the Germania Society. He first produced German opera at Niblo's Garden in New York in 1856. Bergmann was a leader in German-American musical affairs and conducted New York Philharmonic Society concerts. He died at New York, Nov. 30, 1876.

**BERGSON, HENRI** (1859- ), French philosopher, was born in Paris, Oct. 18, 1859. He studied at the Lycée Condorcet and at the École Normale Supérieure. His lectures on philosophy at the Collège de France became immensely popular. He continued lecturing until 1918 when, upon his election to the French Academy to succeed Émile Ollivier, he gave



up teaching to devote himself to writing. Bergson's thought discloses a constant striving to adapt philosophy to reality. He ignored general theories and methods, insisting that philosophy should treat of specific problems, since each problem requires special approach and treatment. In 1928 Bergson was awarded the Nobel Prize for literature.

**BERIBERI**, a disease caused by a vitamin deficiency, occurs particularly in eastern Asia, Japan, the Polynesian Islands, the Philippines and in Brazil. At one time it was associated primarily with moist, warm climates; then, with the prevalence of a rice diet; next, with the possible deterioration of rice to a toxic food in these climates and finally with the lack of an important vitamin in the diets of those affected. It has occurred also in armies, on shipboard and in institutions.

In man, the most usual and earlier form is (a) the "dry" or *atrophic*, detected by an unsteady gait, with muscular weakness, especially of the calves, some edema of the legs and palpitation of the heart, particularly after exertion. Later, general paralysis and muscular atrophy develop. (b) In another type, the *wet atrophic form*, the symptoms described above are accompanied by edema of the ankles, thighs and back, decreased urine excretion and a more marked disturbance of the circulation. The edema may be so marked that the muscular atrophy and general emaciation may not be apparent; however, if treated successfully, the edema promptly disappears with a marked diuresis and then the emaciated condition is easily observed. (c) The *acute pernicious form* usually develops suddenly, either primarily or after one of the forms mentioned. Excitement and overexertion may be contributory factors toward the sudden development of the symptoms, namely, marked heart beating, rapid pulse, pain in the heart region, labored and irregular respiration, nausea, vomiting, diarrhea and marked anuria. In the acute form, death may occur in a few hours to several weeks after the onset of the acute symptoms. The death rate was 60% or higher in some localities and in certain outbreaks, but with the knowledge and treatment now at hand, the mortality has been diminished to considerably less than half of that number. The most uniform and marked pathologic changes observed in human and experimental beriberi are the degenerative changes in the motor nerves. In the early stages, some of the fibers of the peripheral nerves are affected, but later the degeneration progresses more toward the central nervous system. (d) If the symptoms of the first three forms are slight in intensity but of long standing, the case is chronic.

The most significant contribution toward solving the etiology and treatment of beriberi was made by Eijkman in 1896. He observed that a disease similar to human beriberi could be brought about in chickens by feeding them only white or polished rice, and that the addition to the diet of the bran obtained from polishing rice, cured or prevented the disease. He later showed that an alcoholic extract prepared from rice polishings possesses the same curative properties.

His interpretation was that the polished rice contains a toxic substance and that this is neutralized or counteracted by a substance in the rice polishings. His observations have been confirmed repeatedly and the studies have been extended to other animals and other foods with the result that to-day we consider beriberi a true deficiency disease and that it can be prevented or cured by having sufficient of the antineuritic water soluble B vitamin in the food. This vitamin is sometimes called water-soluble B or vitamin B<sub>1</sub>. (*See VITAMINS.*) The numerous investigations with carefully controlled diets on animals show that the disease can be produced in pigeons, rats, cats, monkeys, and dogs by a great variety of specially prepared diets free from the antineuritic vitamin. The vitamin is widely distributed. Yeast is a particularly rich source, then follow the common food seeds and especially the whole corn, wheat, rice, oatmeal, millet, alfalfa. In these it is present in the outer layers as well as in the embryo. The green parts of plants as well as the tubers, such as carrots and potatoes, and most animal tissues, especially heart, liver and kidney, also contain the vitamin.

F. C. K.

**BERING or BEHRING, VITUS JONASSEN** (1680-1741), Danish navigator, born at Horsens, Denmark, in 1680. In 1704, he entered the service of Peter the Great as a naval captain. He made extensive discoveries in the North Pacific Ocean. In 1725, he explored the body of water now known as Bering Strait and proved that Asia and America are separated by water. In 1741, Bering explored the western coast of North America. He died on what was later named Bering Island in Dec. 1741.

**BERING SEA**, the extreme northern arm of the Pacific Ocean, bounded on the west by Siberia, on the east by Alaska and on the south by the Aleutian Islands. To the north, Bering Strait connects it with the Arctic Ocean. Its area is about 886,000 sq. mi., part of which is taken up by groups of islands. The depth of the sea varies from 600 ft. and less in the northern portion, to 6,000 and 10,000 ft. in the southern part. It is noted for its seal fisheries. Bering Strait is 56 mi. wide at its narrowest point and has a depth of 150 ft.

**BERING SEA CONTROVERSY**, a dispute, involving the United States and Great Britain, over the seal fisheries of the North Pacific. After the acquisition of Alaska the American Government regulated seal hunting in the great rookeries of the Pribilof Islands in Bering Sea, only one company being licensed and the slaughter carefully restricted to provide against extermination. Beginning in 1886 unlicensed vessels fitted out in British Columbia hunted the seals feeding in Bering Sea outside the territorial three-mile limit. Great Britain opposed the American contention that Bering Sea, to the western limit covered by the Russian cession, was under the exclusive jurisdiction of the United States, but agreed in 1892 to arbitration. The Court of Arbitration, composed of seven members, one Canadian; one Englishman; two Americans, John M. Harlan and John T.

Morgan, and three from other distinterested countries, met in Paris Mar. 23-Aug. 15, 1893. Its decision denied the American claims to jurisdiction over pelagic sealing; but regulations were adopted, to be enforced by Great Britain and the United States concurrently, providing for a closed season, May 1-July 31, prohibiting pelagic sealing within 60 miles of the Pribilof Islands, and prohibiting the use of unlicensed vessels, steam vessels and explosive weapons in the business. These regulations were ineffectual. The depletion of the seal herd continued at a ruinous rate until, in 1911, a treaty between the United States, Great Britain, Russia and Japan abolished pelagic sealing.

**BERKELEY, GEORGE** (1685-1753), British philosopher, was born at Thomastown, Ireland, Mar. 12, 1685. He was educated at Trinity College, Dublin, where he became a fellow in 1707. That he was interested in public affairs is evidenced by his *Essay Towards Preventing the Ruin of Great Britain*, 1722, concerning the famous South Sea Bubble. In 1711 Berkeley published his *Discourse on Passive Obedience*, in which his political position was defended. Although the Government had promised him £20,000 toward his project for establishing a college in the Bermudas, the venture ended in failure. In 1734 Berkeley was appointed Bishop of Cloyne, which position he held for nearly 20 years. He died suddenly at Oxford, Jan. 14, 1753.

Berkeley is known best for his *Essay towards a New Theory of Vision*, 1710; *A Treatise Concerning the Principles of Human Knowledge*, 1710; *Three Dialogues between Hylas and Philonous*, 1713, and *Alciphron, or the Minute Philosopher*, 1733. The Dialogues are particularly noted for their style.

Bishop Berkeley's name is definitely associated with the philosophy of subjective idealism. His position may be summed up in the following syllogism: There can be no being apart from quality. There can be no quality apart from the mind. Therefore, there can be no being apart from the mind. Permanent things are because they are always perceived by a divine mind. This removed a little of the sting of the argument, but as absurd as the position may seem, it has nevertheless been a great stumbling block for many a philosopher and is by no means easy to meet on its own grounds. The neo-realists have given much attention to refuting this Berkeleyan syllogism, in order that they might once more be able to dwell in a real world.

**BERKELEY, SIR WILLIAM** (c. 1609-77), Colonial Governor, was born near London about 1609. In 1641 he became Governor of Virginia but refusing to side against Charles I, he was replaced by Cromwell in 1652 and retired to his Virginia plantation. After the restoration he was again made governor by Charles II in 1660 but proving unable to cope with wars and disorders in Virginia, notably Bacon's Rebellion, he was recalled to England in 1677. He died at Twickenham July 13, 1677.

**BERKELEY**, a city in Alameda Co., western California, on San Francisco Bay, 10 mi. from San Fran-

cisco; served by buses, steamboats, ferries and two railroads. The chief crops grown in the vicinity are peaches, apricots, walnuts and almonds. The water front is banked with factories which produce ink, soap, serums, toxins, food products, iron, steel and machinery. The manufactured output, 1929, was worth \$49,899,759. In 1929 the retail business amounted to \$2,851,060. In the center of the city is the University of California, occupying 530 acres. The city is the seat also of three theological seminaries and several secondary schools.

Berkeley is splendidly situated on hills overlooking picturesque country on the east and the Golden Gate on the west. Built on an old Spanish grant, it was named for Bishop George Berkeley, the Irish metaphysician (1685-1753). The city's rapid growth dates from 1868, when the University was founded. Berkeley was incorporated as a city in 1909. Pop. 1920, 56,036; 1930, 82,109.

**BERKSHIRE HILLS**, a highland region in Berkshire Co., Mass., comprising the southern extremity of the Green Mountains of Vermont. While less spectacular than other divisions of the Appalachian system, these hills have throughout a quiet charm expressed in long wooded crests, deep spacious valleys and picturesque lakes. They run generally north and south, maintaining heights of less than 2,000 ft. with the exception of about a score of summits including Mt. Everett toward the south measuring 2,624 ft. and Greylock or Saddleback, the highest peak in Massachusetts, with an elevation of 3,535 ft. The slopes are moderate so that the highest points are accessible by roads and trails. Great numbers of tourists visit this region every year and many permanent residents have homes and small farms in the valleys where there are also many towns reached by railroads. The eastern slopes of the hills are drained by the Deerfield and Westfield rivers and the western by the Hoosac and Hoosatic. Pittsfield, the largest city within the region, is situated on the latter river.

**BÊRLAD.** See BARLAD.

**BERLIN, IRVING** (1888- ), Russian-American composer of popular songs, was born in Russia, May 11, 1888, son of Moses and Leah Baline. He was brought to New York in 1893 and attended the public schools in New York for two years. He served as a sergeant of infantry during the World War. He composed *Alexander's Rag Time Band*, *Oh, How I Hate to Get Up in the Morning*, *When I Lost You*, *When I Leave the World Behind*, *What'll I Do*, *All Alone*, *Remember*, *Don't Wait Too Long*, *Always*, *Because I Love You*, *At Peace with the World*, *Russian Lullaby*, and contributed songs to the *Music Box Review*, *Cocanuts* and the *Ziegfeld Follies*. He married Ellin, daughter of Clarence H. Mackay, Jan. 4, 1926. In 1932 Berlin wrote the music for the musical revue, *Face the Music*.

**BERLIN**, capital of Germany and of the free state of Prussia, located in north west-central Germany in the province of Brandenburg, on the navigable Spree River a short distance above its junction with the

Havel. An administrative district in itself, it is the third largest city of the world and has an area of about 33 sq. mi.

**Buildings.** The oldest part of the city has very few medieval buildings, those being mostly churches, as new streets were broken through for the erection of public buildings such as the rathaus, stock exchange, main post-office, commercial buildings and warehouses. In the old city is the former royal palace, built in 1443-51, and rebuilt in the Renaissance and Baroque styles in 1698-1713. Beyond the gardens is the national monument of WILLIAM I, the Marstall and the "Elector's Bridge," with an equestrian statue of the Great Elector, FREDERICK WILLIAM, an important Baroque work of art. Nearby is the New Cathedral, 1844-95, beneath which is the Hohenzollern crypt with 87 coffins. Farther on is the Museum Island with the Old Museum, New Museum, National Gallery, Pergamon Museum and Kaiser Friedrich Museum, all of the 19th or early 20th centuries. The Castle Bridge leads across the river to a broad square, Berlin's most sumptuous section, which in the past was the background of court and military spectacles. At its eastern end stands the Arsenal, 1644-1706; on the south lie the former palace of the crown prince, 1663, and the State Opera, 1741-43. Its continuation is the famous Unter den Linden boulevard ending in the Pariser Platz. On the south of this square is the Academy of the Arts; on the north, the French embassy; and on the west, the Brandenburger Thor, beyond which is the Tiergarten. Unter den Linden also contains at its eastern end the palace of William I, the buildings of several ministries, the Russian embassy and the leading hotels. To the south on Friedrichstrasse and Leipzigerstrasse is the tourist center with fine shops and department stores; the streets nearby house the large banks and corporations.

On the Wilhelmstrasse, stretching south from the western end of Unter den Linden, are the majority of the federal and Prussian government departments, including the palace of the president. The Tiergarten on the west is bounded on the north by the Spree. With its fine trees and picturesque lakes, it has retained some of the features of a natural park. It contains monuments of Goethe, Lessing, Friedrich Wilhelm III, Queen Louise and Richard Wagner. Further west is the Zoological Garden, adjoining which is a favorite residential section of well-to-do people; but business is encroaching south of the Tiergarten. The recent movement toward the west has made the Kurfürstendamm one of the liveliest business streets and has produced a new center. The sections to the south and southwest are inhabited mostly by people of moderate means. The southeast has become a business and factory section to a considerable degree and there are countless rows of tenement houses, though there is the redeeming feature of wide streets and frequent green areas. The north and northwest sections have many medical institutes, schools, the Natural History Museum, Federal Ministry of Labor, large industrial works and homes for people of moderate means.

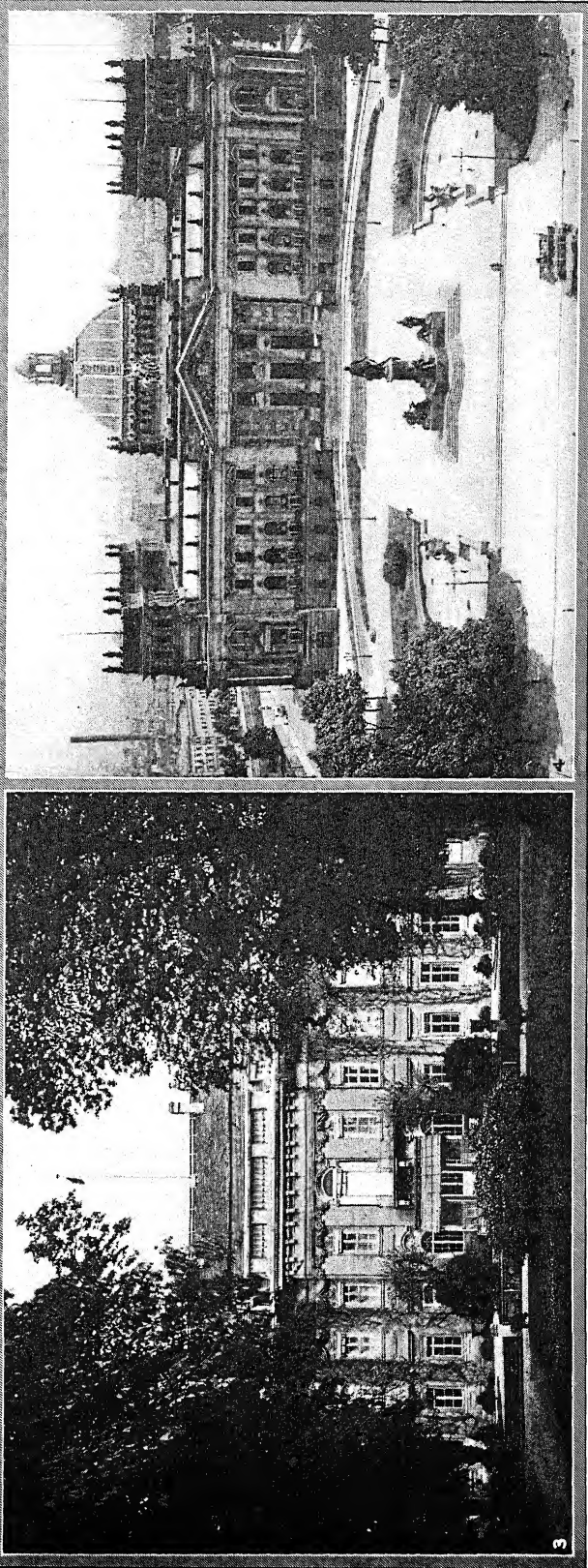
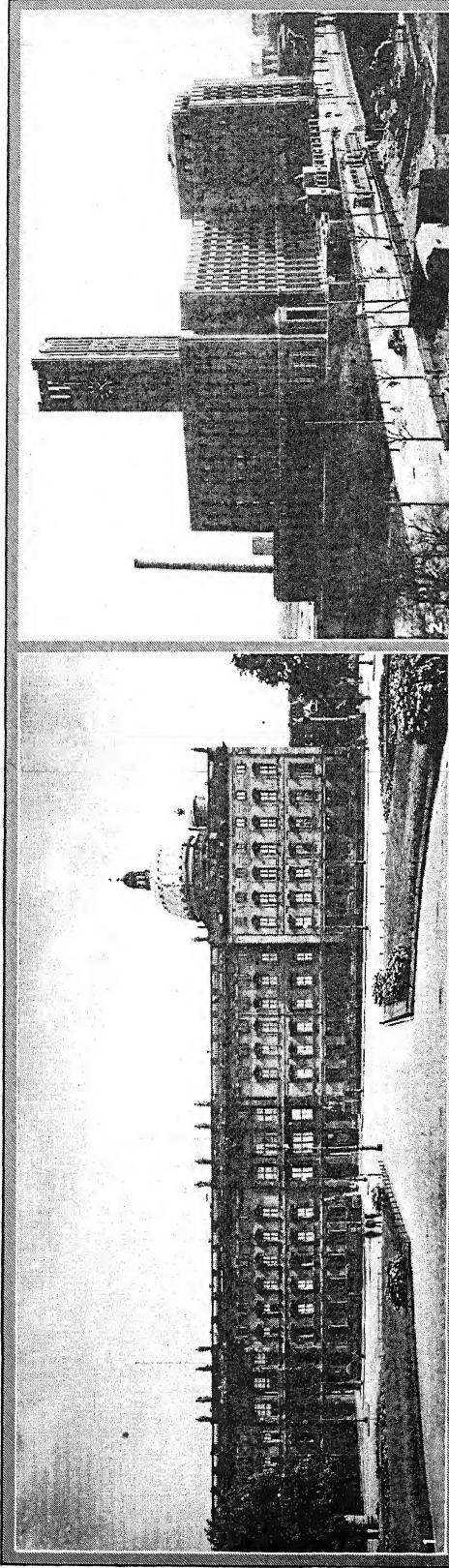
South of the Spree and bordering on the Tiergarten is a fashionable section around the Square of the Republic, formerly Königsplatz, with the victory column of the war in 1864. On the east is the Bismarck Monument and on the west, in front of the Kroll Opera House, that of Moltke.

The Old Museum contains collections of classical antiquity, the New Museum the Egyptian collection and copper-plate etchings; the National Gallery, German painting and sculpture from the end of the 18th century. The new section of the National Gallery in the former palace of the crown prince contains the most modern works of art. The Kaiser Friedrich Museum has five collections of early Christian and Byzantine works of art, early Italian paintings together with collections of Near-Eastern, Coptic-Persian and Islamic art, and also a picture gallery of the Romanesque and Germanic schools from the 13th century to the end of the 18th century. In addition to the fine zoological garden, with an aquarium and insectarium, there is nearly a score of other museums with valuable special collections. The number of learned, philanthropic and other associations is legion. Until 1900, all the theaters were in the center of the city, but later a new theatrical district arose in the west and one-fourth of the 58 theaters are in that section. There are now three opera houses, and superb concerts are given under famous directors.

**Transportation.** The development of transportation has been greatly influenced by the canal and river communications which terminate at Breslau, Warsaw, Danzig, Königsberg, Kovno, Stettin, Lübeck, Hamburg and Prague. Contact with the Mittelland Canal is to unite Berlin with west and south Germany. Berlin's water transportation has made it the largest interior port next to Duisburg-Ruhrort. The chief products thus transported are coal, lumber, building materials and food products. Berlin's size and situation have made it not only the railroad center of north Germany, but also of central Europe. The passenger traffic is served by a large number of separate stations. Local traffic is taken care of by the city and ring railways, as well as by suburban lines. The strictly local lines are mostly electric. Rapid transit within the city is furthered by the elevated and subway lines. In 1927, a uniform class and rate were introduced. The 89 electric surface lines were united since the World War. There is airplane service in all directions over 18 routes. Besides motor-bus companies, with 321 buses, there are 9,500 taxicabs, and excursion steamers on the Spree and other rivers.

**Manufactures and Trade.** Berlin is one of the most important manufacturing cities of Europe. Nearly two-fifths of all the industrial workmen of the capital are employed in the large establishments of the electro-chemical, machine, apparatus and motor-vehicle industries. The clothing and underwear industry employs one-fifth of the clothing and underwear workers of Germany. In the manufacture of cigarettes, Berlin is next to Dresden and maintains, as well, a good position in many other diversified indus-

# BERLIN

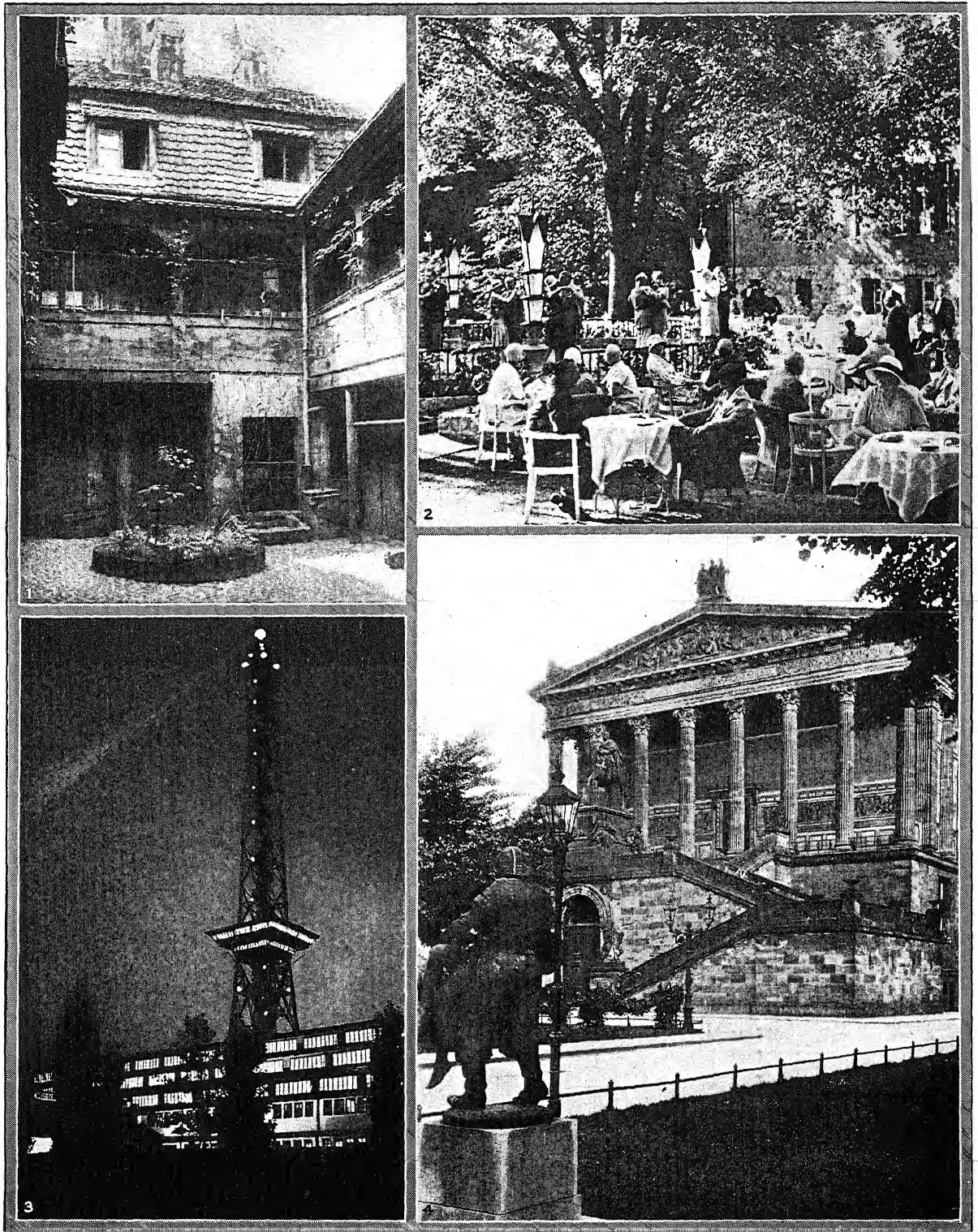


## FAMILIAR SCENES IN BERLIN

1. The former royal palace, now a museum.
2. Ullstein House, a modern newspaper plant in Berlin.
3. Residence of the President of the Reich seen from the garden.
4. Republic Square with the Reichstag and Bismarck monument.



## BERLIN



COURTESY GERMAN TOURIST INFORMATION OFFICE

### THE BERLIN OF YESTERDAY AND TO-DAY

1. An old courtyard in the Petristrasse, dating from 1743. 2. Tea-dancing in a fashionable garden café.  
3. Radio tower and modern exposition hall. 4. The National Gallery on Museum Island, rich in paintings and sculptures.



tries. The largest brewery in the world is in the German capital. Berlin is a great trade center, as more than 10% of Germany's total commerce is concentrated here, the chief products being textiles, food products, iron and steel wares.

**Finance.** Besides the Reichsbank and the Prussian State Bank, all the largest banks in Germany have their main offices in Berlin. One-fourth of all German stock companies and one-third of the limited companies are established here and, with the exchanges, make the capital also the financial center.

**Education.** The Friedrich Wilhelm University, founded in 1810, is at the head of the institutions of learning and is followed by a Technical University in Berlin-Charlottenburg, a Veterinary School, Music University, Commercial School, and an imposing number of other institutions. Among the academies and research institutes, the most important are the Academy of Science and Academy of Art, Kaiser Wilhelm Gesellschaft for the Furtherance of Science, with a research institute, a Meteorological institute, a Geodetic Institute, the Geological Landesinstitute and the Botanical Garden. There are many large libraries, of which the foremost is the Prussian State Library, founded in 1659, with 1,752,000 volumes, including 6,191 incunabula, more than 300,000 manuscripts and large map and music sections. Other libraries swell the number, ranging from the university library to reading halls for children.

**History.** Towards the end of the 12th century, German colonists apparently took possession of the Slavic settlements of Berlin and Kölln, and the double city became of some importance in the following century. It was the head of a league of cities in the tumultuous 1500s, but was unable to maintain its almost independent position against the power of the Hohenzollerns who ruled Brandenburg, the nucleus of modern Prussia since 1415. It became the permanent residence of the rulers at the close of the 15th century. The Great Elector, Frederick William, enlarged and beautified his capital and his son, Frederick I, the first king of Prussia, erected splendid buildings. **FREDERICK THE GREAT**, though seldom in Berlin, built palatial structures and promoted commerce and industry. His successors added many edifices in classical style, and Berlin's development was retarded but little by the Napoleonic wars. After the Peace of 1815 came the period of Humboldt, Hegel and other scholars, and also of able architects and sculptors. At the close of the Franco-German War in 1871, under William I, Berlin developed in a manner comparable only with that of American cities. While the inner city became a business section, new suburbs arose and grew rapidly. An association of the neighboring cities and towns was organized in 1912, and in Oct. 1920, seven large and many small suburbs became districts of Greater Berlin.

**Population.** The Berlin type of people is due to a mixture of German—mostly Low German—Slavic, Holland Dutch and French immigrants. The large foreign colonies, amounting to over 106,000, include

1,400 English and 1,100 Americans. The tourist trade reached 1,746,000 in 1927, the largest contingent coming from the United States. Pop. 1929, 4,346,437.

**BERLIN**, a pulp and paper manufacturing city in Coos Co., northeastern New Hampshire, situated on the Androscoggin River. Two railroads afford transportation. Berlin is in the midst of the White Mountains, 16 mi. from the foot of Mt. Washington, and surrounded by a vast region of timber. The falls in the river generate hydro-electric power for the mills which turn out large quantities of bond, newsprint and other classes of paper. In 1929 the manufactures reached an approximate total of \$35,000,000; the retail trade amounted to \$7,662,151. The site of Berlin was a grant to Sir Walter Mayne in 1771. The city was chartered in 1897. Pop. 1920, 16,104; 1930, 20,018.

**BERLIN, CONGRESS OF.** Following a series of so-called Bulgarian atrocities and other disorders in the Ottoman Empire, Russia, on Apr. 24, 1877, declared war upon the Sultan. In less than a year's time the Turks asked for peace, and on Mar. 3, 1878, the Treaty of San Stefano was concluded. By its terms Russia was to receive three Armenian provinces, a section of the arid Dobrudja (which, it was hoped, might later be exchanged with Rumania for fertile Bessarabia), and a large indemnity. In addition, Turkey was to recognize the independence of Serbia, Montenegro and Rumania, each of which three regions was also to be enlarged territorially; an autonomous Greater Bulgaria, including Bulgaria proper, Rumelia, and Macedonia, was to be created; reforms were to be instituted in the administration of Bosnia and Herzegovina; the Dardanelles and the Bosphorus were to be open at all times to peaceful commerce; and all Turkish fortifications along the Danube were to be demolished. Russia obviously was to become the dominant power in the Balkan Peninsula.

The San Stefano arrangement, however, was highly disagreeable to a number of powers. Serbia and Greece protested because all of Macedonia was assigned to Bulgaria. More important, of course, were the objections of Great Britain and Austria-Hungary. The former complained because it had no intention of permitting Russia to exercise control over the various portions of a dismembered Ottoman state. Austria-Hungary refused to countenance the creation of a Greater Bulgaria which would effectually block its plans for a port on the Aegean Sea, preferably Saloniki. It was also generally felt that the large indemnity would practically mortgage Turkey to the Tsar for an indefinite period. The interested powers, therefore, indicated to Russia their firm belief that any alteration of the Balkan situation was a matter of concern to all those European states which had been a party to the Treaty of Paris in 1856, following the Crimean War. These powers included Great Britain, Austria-Hungary, Germany, France and Italy, as well as Russia and Turkey. Faced with the alternative of war, Russia agreed to submit the whole question of a Russo-Turkish peace treaty to an international con-

gress. Upon Bismarck's invitation, the diplomats gathered at Berlin in the summer of 1878.

The Congress blithely disregarded the San Stefano document and proceeded to draw up an agreement which was a compromise between the conflicting Near Eastern interests of Russia, Great Britain and Austria-Hungary. Signatures were affixed to a new set of dispositions on July 13. Russia was permitted to retain the Armenian provinces Kars, Ardahan, and Batum in the Caucasus just as these had been assigned her in the earlier treaty. Further, Rumania was made to cede Bessarabia to Russia, in return for most of the less attractive Dobrudja area. To compensate for these Russian gains, Austria-Hungary was allowed to occupy and administer the provinces of Bosnia and Herzegovina, to maintain garrisons and military roads in the adjacent Turkish sanjak of Novi Bazar, and to acquire certain special commercial privileges in Montenegro. England, by a separate Convention of June 4, was permitted to administer the island of Cyprus as a pledge of the Sultan's earnest intentions to improve the lot of his Christian subjects.

The independence of Serbia, Montenegro and Rumania was recognized, but each of these states was made to assume part of the Turkish debt. Greece, which had received nothing by the Treaty of San Stefano, now found the powers recommending that the Sultan cede to it Thessaly and part of Epirus, and this, in fact, was done in 1881. Greater Bulgaria was split into three sections: the northern part, Bulgaria proper, was made an autonomous principality with the Sultan as suzerain; the middle portion, Rumelia, was accorded administrative autonomy under a Christian governor; Macedonia, the southern third, was restored to Turkey. Finally, the Sultan promised to introduce certain progressive reforms and safeguards, particularly where the Christians were concerned. There remained of Turkey-in-Europe only the provinces of Albania, Rumelia, and Thrace. But with solemn mien the European diplomats once again promised to uphold the "integrity of Turkey."

It is small wonder that the Berlin arrangements satisfied only a few participants. Bulgaria's hopes for a great future were dashed to the ground. Serbia and Rumania had been better treated under the Russian scheme. Greece merely had its appetite whetted. Russia became estranged from Germany, and the Austro-Russian quarrel for Balkan dominance began in earnest. Austria-Hungary and Serbia became bitter foes. The seeds for innumerable quarrels between the new Balkan states were sown, and through the creation of these states, "the sick man of Europe became surrounded with expectant heirs."

W. C. L.

See T. E. Holland, ed., *The European Concert in the Eastern Question: a Collection of Treaties and Other Public Acts, 1885*; R. W. Seton-Watson, *The Rise of Nationality in the Balkans, 1917*.

**BERLIN, TREATY OF**, proclaimed Nov. 14, 1921, a treaty establishing peace between the United States and Germany. It was negotiated by Ellis Loring Dresel, Commissioner to Germany, for the

United States, and Dr. Friedrich Rosen, the German Minister of Foreign Affairs. On July 2, 1921, President Harding approved a joint resolution of Congress declaring that the state of war with Germany, established by the joint resolution of Apr. 6, 1917, was at an end, with the proviso that the United States reserved the "rights, privileges, indemnities, reparations, or advantages, together with the right to enforce the same" gained by the Armistice of Nov. 11, 1918. The purpose of the treaty was the formal restoration of friendly relations. Germany acceded to the proviso in the joint resolution of July 2, and further agreed that the treaty should not affect the rights gained by the United States in the **TREATY OF VERSAILLES**, "notwithstanding the fact that such treaty has not been ratified by the United States."

**BERLIN, UNIVERSITY OF**, at Berlin, Germany, the largest of the German universities, known also as the Royal Friedrich Wilhelm University. Its origin in 1809, when it was founded by Friedrich Wilhelm III, was directly due to Prussia's loss to Napoleon of her former University of Halle. The university has had some of the most eminent German scholars in its professorial chairs. Among them have been Mommsen, Curtius, Helmholtz, von Ranke, the Grimm brothers, Fichte, Hegel, Niebuhr, Ritter, Neander and du Bois Reymond.

The number of students at the university, including women, is about 10,500. Its administration is in the hands of a rector, a senate, the *plenum*, or full body of the professors, and the various faculties. Like other German universities, it is under the direction of the Minister of Education. In 1931 the *rector magnificus* was Dr. Erhard Smidt. From the beginning the main faculties of the university: theology, jurisprudence, medicine, arts and sciences, have been housed in the Prince Henry Palace, 1764, in Unter den Linden. The library of the university, founded in 1831, contains approximately 380,000 bound volumes.

**BERLIN DECREE**, the name of the Napoleonic decree which laid down the main lines of the Continental System, by which the French Emperor hoped to exclude English commerce and English goods from all parts of Europe and to defeat England by destroying her economically. The Berlin Decree, Nov. 20, 1806, proclaimed the British Isles to be in a state of blockade, and prohibited trading with England or her colonies. England replied by an Order in Council authorizing the seizure of all neutral vessels sailing to French ports, and forbidding commerce with all countries which excluded the British flag. The two decrees were ruinous to world trade, but more so to France than to England, which had the greater number of ships, and after Trafalgar control of the sea. American shipping was severely crippled by England's reprisals against the Berlin Decree, and the WAR OF 1812 was one of the results of these British counter-measures.

**BERLINER, EMILE** (1851-1929), American inventor, was born at Hanover, Germany, May 20, 1851. He was graduated at Samson College, Wolfenbuttel,

in 1865, went to America in 1870, and settled in Washington, D.C. While chief instrument inspector of the Bell Telephone Co., 1879-82, he discovered the loose contact principle of telephone transmitters and introduced the use of induction coils. He invented the gramophone in 1887. From 1901 he conducted an educational campaign against the danger of raw milk and founded the Bureau of Health Education. He was the first to use the light-weight revolving cylinder in helicopters in 1907-08. He died at Washington Aug. 3, 1929.

**BERLIOZ, HECTOR LOUIS** (1803-69), French composer, was born at La Côte St. André, Dec. 11, 1803. He renounced the medical career which his father planned for him, and entered the Paris Conservatoire. In 1830 he won the Prix de Rome with his cantata, *La Mort de Sardanapale*. A sojourn in Italy followed. Unable to make a living as a composer he took to journalism, but PAGANINI came to his aid with a gift of 20,000 francs, and he made a tour of Germany, where he rapidly won recognition as a composer. A *Te Deum* and a cantata, *L'Imperiale*, written for the Paris Exposition of 1855, brought him the Legion of Honor and led to his election to the Academy and his appointment as librarian of the Conservatoire. His chief works are the operas *Benvvenuto Cellini* and *Les Troyens*, the dramatic legend, *La Damnation de Faust*, the oratorio, *L'Enfance du Christ*, the *Symphonie Fantastique*, and the symphonies *Harold en Italie* and *Romeo et Juliette*, the overtures *Corsair*, *King Lear* and *Le Carneval Romain*, and a requiem inspired by the death of Napoleon. Time has severely worn their musical value, but their author's contribution to the color and technic of the orchestra by means both of these works and of the valuable *Treatise Upon Modern Orchestration*, make him one of the outstanding figures in French music. He died at Paris, March 8, 1869.

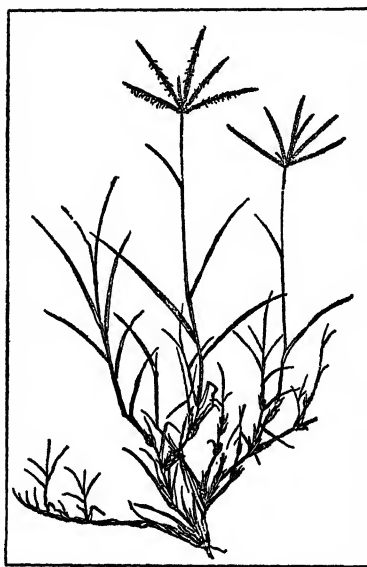
**BERMUDA**, also known as Somers Islands, a group of British islands in the Atlantic in 32° 15' N. lat. and 64° 51' W. long., approximately 667 mi. from New York and 580 southeast from Cape Hatteras. The Bermuda group consists of about 300 islands of coral formation arranged in the shape of a sickle. Their total area is 20 sq. mi. The principal island, Great Bermuda or Main Island, near the head of which, Hamilton, the capital, is situated on a deep inlet, is 14 mi. long and has an average width of about one mile. The entire chain of islands is connected by means of bridges and causeways for a distance of 22 mi. The group is comparatively flat, the highest elevation being only 245 ft. The British government has a strong garrison stationed on the islands, which are one of the chief naval and coaling depots of the Empire.

Although only a quarter of their area is suitable to cultivation, the islands yield crops of potatoes, onions, tomatoes and other produce which find a market in the United States during the months when those products are not in season there. Other important crops are cotton, coffee and tobacco; lily bulbs are

raised in large quantities. Fish, which abound in great variety in surrounding waters, also form the basis of a profitable local industry. Small vessels and boats are built from the Bermuda Cedar, belonging to the juniper species.

The climate, although less even than that of the islands within the tropics, is particularly good during the winter months, when the temperature averages between 60° and 70° F. The maximum temperature is about 87° F., and the annual rainfall 60 in. The islands attract a large number of visitors annually from North America.

The Bermudas were discovered in 1519 by Juan de Bermudez, a Spaniard. In 1609 the *Sea Venture*, one of an expedition of ships bound to Virginia for the relief of Jamestown, was wrecked near the group of islands, with Sir George Somers on board. After his escape to the mainland, the English called the Bermudas the Somers Islands. They were settled by the English in 1612, and were first a proprietary, then a royal colony. The inhabitants turned very early to salt manufacture and commerce for their livelihood. During the Revolutionary War the islands provided powder from the royal magazine to the Continental soldiers. During the Civil War they were intermediate points for blockade runners sailing to and from England and the South. In the 20th century their fine climate and beautiful scenery have attracted a great number of tourists. They are governed by a Colonial Parliament and a governor appointed by the King of England for a term of three or five years. Pop. 1931, 27,789.



COURTESY U.S. DEPT. AGRIC.

BERMUDA GRASS

**BERMUDA GRASS** (*Cynodon Dactylon*), a valuable pasture grass, called also crab grass and scutch grass, native to the Old World but now widespread in all warm regions. It is a low creeping perennial with short leaf blades and upright flowering stems,

about 1 ft. high, bearing several slender spikes that radiate from the summit. In the United States Bermuda grass occurs as far north as Massachusetts and extends westward to California. It is the most important pasture grass in the southern states where it is used also for lawns. In moist alluvial soils sufficiently rich to support a rank growth Bermuda grass is grown for hay. Because of its long horizontal rootstocks, which root firmly at the joints, Bermuda grass is used as a dune binder. It sometimes becomes a pestiferous weed especially in irrigated areas.

**BERN** or **BERNE**, a city of Switzerland, capital of the Swiss canton of the same name and of the Swiss Confederation, beautifully situated on the Aar River. It is the seat of the International Postal Union and of a university. Bern is the most typically Swiss of the larger cities, with its fine houses, wide streets and arcades on both sides. Noteworthy among the buildings are the Parliament House, where the administrative offices are also housed, the late-Gothic cathedral, the various museums, the Rathaus with the bear pit, monuments and fountains. The chief products are cotton, silk and metal goods, and book bindings. Founded in 1191 by Berthold V of Zähringen, it became a free imperial city in the 13th century and was strong enough to withstand the power of Rudolph of Hapsburg and the Burgundian nobility. Bern joined the Swiss Confederation in 1353 and accepted the Reformation in 1528. Pop. 1930, 111,597.

**BERNADOTTE, JEAN BAPTISTE JULES.**  
See CHARLES XIV, JOHN.

**BERNARD, CLAUDE** (1813-78), French physiologist, was born at Saint-Julien, France, July 12, 1813. The son of a small land owner, he left school early, probably for financial reasons, to become a pharmaceutical assistant. In his spare time he tried his hand at literary work with meager success. In 1834, having written a five-act tragedy, he went to Paris to submit his work to a great dramatic critic of the time. But the play evidently did not appeal to the critic, who advised him to study medicine. He took this advice and eventually came in contact with Magendie at the Hôtel-Dieu. He was so successful here that Magendie soon made him his assistant ("preparateur"), and in 1855 he was appointed successor to Magendie as professor of physiology in the Collège de France. His domestic life was a failure. Wife and daughters left him. One daughter, opposed to the nature of his vivisection experiments, established a home for cats and dogs to atone in part presumably for Bernard's use of them in his great medical discoveries.

In the course of his experimentation in physiology, Bernard discovered that the liver can store the excess of sugar fed in the form of a starch known as glycogen; that the liver can reconvert this glycogen into sugar and pass it off into the blood stream for use throughout the body as needed. He discovered the fat, protein, and carbohydrate digesting power of the pancreatic juice, so important in the digesting of our meals. He discovered that the muscle cells of the smaller arteries were under nervous control by means

of which the caliber of the vessels could be changed, thus varying the amount of blood going to the various organs. This discovery is of the utmost significance in our knowledge of the regulation of blood pressure and other physiological phenomena. He showed the manner in which carbon monoxide (in illuminating gas) kills, and made many other technical contributions. Bernard's success in experimental physiology and medicine was due to his manual dexterity and to the keen, critical and analytical powers of his mind. A brilliant imagination projected experiments; in the laboratory he was austere and objective. He died in Paris, Feb. 10, 1878. A. B. L.

**BERNARDIN OF SIENA, ST.** (1380-1444), Franciscan friar and preacher, was born in Massa, Italy, in 1380, of noble parentage. After exhausting himself in the service of the sick during the plague, he entered the Franciscan Order in 1402. Here the zeal and fervor of his religious convictions attracted many converts and he was elected vicar-general of his order. His writings are famous in ascetic literature, and his sermons have won universal approval. His efforts are reputed to have contributed considerably to the religious revival of the 15th century. St. Bernardin died at Aquila in the south of Italy in 1444 and was canonized six years later. His day is kept on May 20.

**BERNARD OF CLAIRVAUX, ST.** (1090-1153), preacher and statesman, was born in 1090 at Fontaine near Dijon. He was a Burgundian of noble family, and his father, Tecelin, died in the First Crusade. He was early left an orphan, and sensible of a vocation, studied for the priesthood at Châlons. To the disappointment of his family, however, he forsook the path to promotion and joined the CISTERCIANS at Cîteaux, an abbey so greatly assisted by his influence that a second foundation at Clairvaux was established, where Bernard became abbot. It was his austere piety and often masterful preaching that drew crowds of pilgrims to Clairvaux, where it was noticed that the Abbot attributed miracles to his friend, St. Malachi, never to himself. To-day the hymns, *Jesus the very thought of thee* and *Jesus, thou joy of loving hearts* perpetuate the tender reverence of St. Bernard; yet amid his devotions he was forced into public affairs. In 1128 he drew up the rules of the Knights TEMPLARS, and on Feb. 13, 1130, a more serious task was thrust on him. Pope Honorius II died, and that night a minority of Cardinals elected Innocent III, who was hastily consecrated. The choice was disputed. (See BENEDICT VII.) At an earlier date a wealthy Jew had been converted and baptized, assuming the name Pierleone after his godfather Leo IX. His son became governor of the Castle of St. Angelo, and his grandson was Cardinal Peter Pierleone. A majority of Cardinals elected him to be Pope (or antipope) Anacletus II, and with the city of Rome against him Innocent III fled. To St. Bernard, Rome was in the wrong and fiercely did he denounce her citizens. "They will not submit; they know not how to govern," so ran his invective, and



## BERMUDA



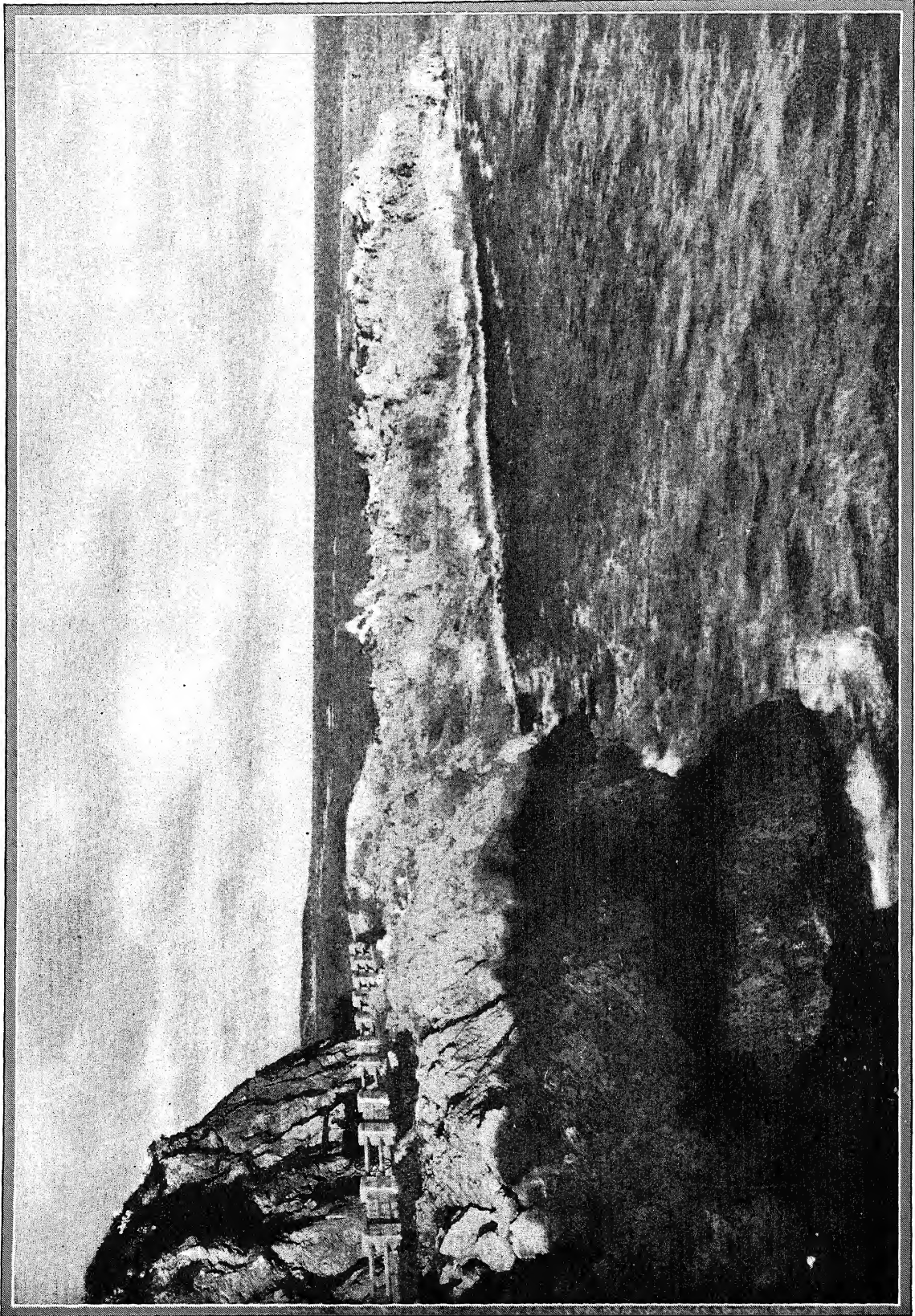
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### BERMUDA—A GARDEN SPOT IN THE ATLANTIC

Two aerial views of St. George in Bermuda. A panorama, showing St. George at left and the homes dotting the coral reef shores. At top, the town of St. George, formerly the capital, located on the island of St. George.

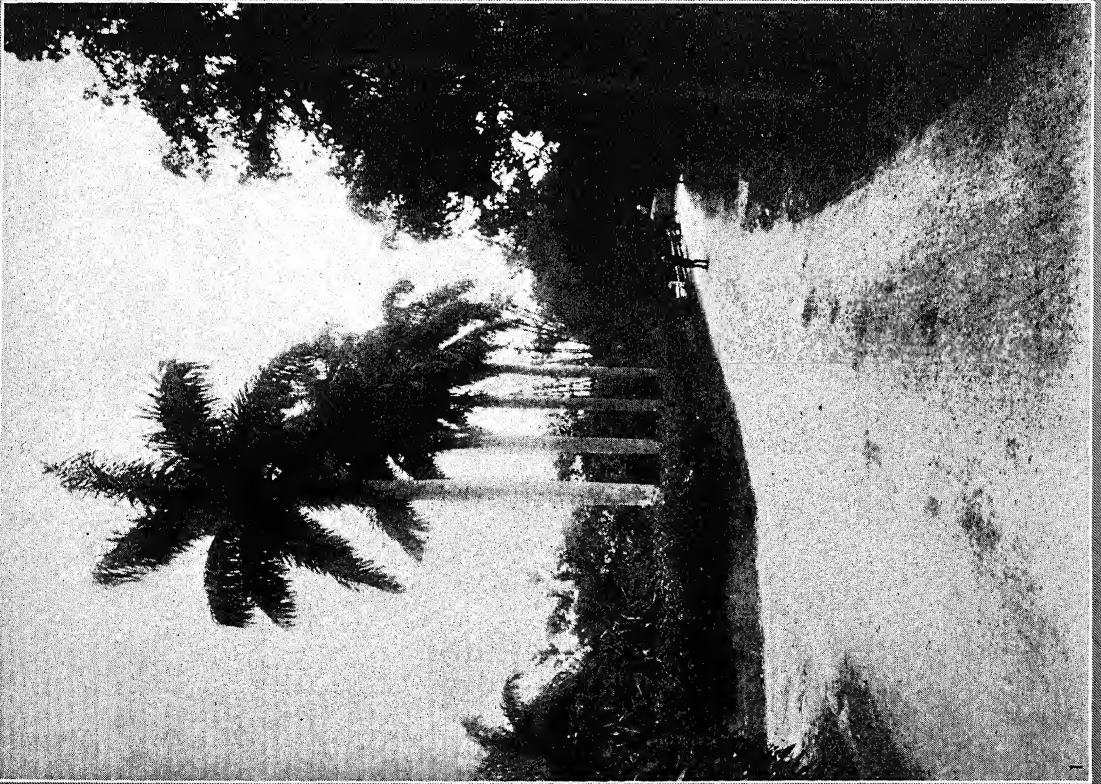


BERMUDA



TUCKER'S TOWN ROAD IN BERMUDA, AN ISLAND OF SCENIC BEAUTY

## BERMUDA



1, COURTESY BERMUDA TRADE DEVELOPMENT BOARD; 2, WENDELL P. COLTON CO., NEW YORK

A PALM-LINED ROAD AND A TROPICAL LANDSCAPE GARDEN OF THE BERMUDAS



it was his view that Innocent was "accepted by the world." Bernard's aim was to close the schism, and he succeeded. In 1138 Anacletus died, being followed by a second antipope, Cardinal Gregory, who assumed the name of Victor. By personal influence Bernard persuaded Victor to abdicate and the Pontificate was again undisputed. In 1146 Bernard proclaimed the Second Crusade. At Vezelay his sermon led Louis VII of France to join the crusade. At Spire, Conrad, King of the Romans, was also persuaded to assume the cross. But the Crusade failed and Bernard's cares were increased by the emergence of heresy in Languedoc and elsewhere. Arnold of Brescia, moving the factions in the Eternal City, seemed to him to be an enemy of religion. Powerful in combat, Bernard was no less constructive in organization and 160 monasteries remained as witness to his zealous ability.

**BERNARD OF CLUNY**, Benedictine poet and satirist, was born probably in the very early years of the 12th century, it is thought at Morlaix in Brittany. He was a member of the abbey of Cluny under Peter the Venerable, 1122-56, and there wrote the famous satire *De Contemptu Mundi*, in which he exposed the vices and corruption of the medieval Church. From the Latin of the first section J. M. Neale wrote the hymn "Jerusalem the Golden." In his poem Bernard approaches the genius of Dante in his use of rhythm and in his graphic picturization.

**BERNARD OF MENTHON, ST.** (923-1008), was born in 923 and died in 1008. He is memorable as the founder of the monastery 8,000 ft. above sea level on the summit of the Great St. Bernard Pass, with a second hospice on the Little St. Bernard Pass, 7,076 ft. above sea level. The monks, numbering about 40 and assisted by the trained St. Bernard dogs, render aid and comfort to travelers. In May, 1800, Bonaparte, crossing the Alps with his army, spent an hour at the monastery on Great St. Bernard and thanked the monks for giving his soldiers bread, cheese and a glass of wine.

**BERNBURG**, a city in Anhalt, a German free state, lying on both banks of the Saale River, about 22 mi. west of Dessau. Picturesquely situated high above the river is a castle, part of which was built in the 14th century. The most prominent of many industries are potash mines and chemical factories; agricultural machinery and paper are also manufactured. The city has large trade in agricultural products. Pop. 1925, 34,305.

**BERNHARDI, FREDERICH VON** (1849-1930), German militarist and author, was born at Petrograd (Leningrad), on Nov. 22, 1849. He served in the Franco-Prussian War, and in 1891-94 was at Berne, Switzerland, as military attaché. He headed the military history department of the general staff in Berlin and in 1907-09 was commander of the Seventh Army Corps. In 1909 he retired to write on subjects of a military nature, and in 1912 he published *Deutschland und der nächste Krieg*, which is constantly cited in allied countries as proof of Germany's guilt and her

desire for war. In it he proclaimed the doctrine of armed might by which Germany was to win the victory at any cost. He commanded an army corps in 1915, and in 1918 commanded a body of troops at Armentières. In 1921 he published *Deutschlands Heldenkampf 1914-18*. He died July 10, 1930.

**BERNHARDT, SARAH** (1844-1923), French actress, was born at Paris, Oct. 22, 1844. Her mother was a French Jewess but her father had her baptized in the Catholic Church and educated in a convent. In 1865 she won the Paris Conservatoire prize for both comedy and tragedy. Her first triumph occurred in 1867 when she played the queen in Hugo's *Ruy Blas*. Between 1886 and 1917 she made repeated tours in North and South America and in other parts of the world. In tragedy Sarah Bernhardt has been ranked next to Élixa Rachel and in comedy she had few superiors. She had a matchless voice, artistic poise and movement, and was excelled by no actress of her time. Her most celebrated rôles, at the Comédie-Française in Paris and while on tour, included Camille, Cleopatra (in Sardou's drama), the Duc de Reichstadt in *L'Aiglon*, and La Tisbé in Hugo's *Angelo*. She exhibited painting and sculpture above the average and wrote two successful plays, *Adrienne Lecouvreur* and *Un Coeur d'Homme*. She played near the French front during the World War in spite of the fact that she had lost a leg as a result of an accident. She was awarded the Legion of Honor in 1914. In 1917 she made a last tour of the United States, often appearing in behalf of organizations engaged in war relief. She died at London, Mar. 18, 1923.

**BIBLIOGRAPHY.**—S. Bernhardt, *Memories of My Life*, 1908; B. Woon, *The Real Sarah Bernhardt*, 1925.

**BERNICIA**, an Anglo-Saxon kingdom of the 6th and 7th centuries stretching northward from the Tyne to the Forth and after 633 united with the immediately southern kingdom of DEIRA to constitute the kingdom of NORTHUMBRIA. King Ida, ruling about the middle of the 6th century, is the first recorded king of Bernicia. After the rule of King Edwin Bernicia lost its separate identity and merged with the kingdom of Northumbria.

**BERNINI, GIOVANNI LORENZO** (1598-1680), Italian sculptor, painter and architect, was born at Naples, Dec. 7, 1598. He finished his first group, *Apollo and Daphne*, at the age of 18. Pope Urban VIII employed him to design embellishments of the basilica of St. Peter's at Rome. The large canopy covering the high altar of St. Peter's and the front of the Collegium de Propaganda Fide were also done by him. His greatest architectural work is the colossal colonade of St. Peter's. In 1665 Louis XIV invited Bernini to Paris where he made designs for the east front of the Louvre. He made the Versailles bust of Louis XIV. Bernini died at Rome, Nov. 28, 1680.

**BERNOULLI NUMBERS**, known also as Bernoullian Numbers, a series of fractions beginning with  $\frac{1}{2}$ ,  $\frac{1}{4}$ ,  $\frac{1}{8}$ , and designated respectively by the symbols  $B_1$ ,  $B_2$ ,  $B_3$ . The name was given to them in honor of their discoverer, Jacques Bernoulli, who used them in



summing the  $n$ th powers of the first  $x$  integers, his formula being

$$S_n = 1 + 2^n + \dots + x^n = \frac{x}{n+1} + \frac{x}{2} - \frac{n}{2} B_1 x^{n-1} + \frac{n(n-1)(n-2)}{4!} B_2 x^{n-3} + \dots$$

Bernoulli Numbers have numerous applications in the theory of numbers, the calculus of differences, and the theory of definite integrals. They also appear as coefficients in the expansion of  $\frac{x}{e^x - 1}$ . Many formulas for these numbers have been developed as well as a number of interesting generalizations. J. G.

**BERNOULLI'S THEOREM.** A principle of physics stating that the total ENERGY of a particle of a liquid flowing through an orifice remains constant, the potential energy decreasing as the kinetic energy increases. When a liquid escapes through an opening

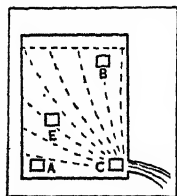


FIG. 1

near the bottom of a tank, as shown in Fig. 1, the whole of the liquid is in motion, each part moving along a definite path, or stream-line, toward the opening. The dotted lines represent the stream-lines in the simple case of flow considered here. It is obvious that stream-lines are relatively far apart in regions of low velocity and close together in regions of high velocity. That part of the liquid near the opening is moving rapidly and has relatively large kinetic energy, while the portions far removed from it are moving slowly, and have relatively little kinetic energy. On the other hand, those portions which lie at some distance from the opening are either under pressure, as at A, or at an elevation, as at B, so that they have larger potential energy than those portions near the opening. As a particle approaches the opening from the positions, A or B, it gradually loses potential energy on account of its increase in velocity. If there were no fluid-friction effects (*see* VISCOSITY) each particle would flow down and out through the opening with exactly the same total energy, its gain in kinetic energy being equal to its loss in potential energy.

Bernoulli's Theorem may be explained by considering any particle, E, of unit volume moving with a velocity,  $v$ , along its stream line toward the opening in the side of the vessel. Its kinetic energy may be expressed by  $\frac{1}{2}dv^2$ , where  $d$  is the density of the liquid. The particle, E, is  $h_1$  cm. above the opening and, therefore, has potential energy with reference to that point, which may be expressed by  $h_1dg$  when  $g$  stands for the acceleration of gravity. It is  $h_2$  cm. from the surface of the liquid, hence, is under a pressure,  $P = h_2dg$ , and has pressure-potential energy to that amount. The total energy of the particle is made up of these three parts, and according to Bernoulli's Theorem, is constant. We may, therefore, write:  $\frac{1}{2}dv^2 + h_1dg + P = \text{a constant}$ .

The particle, B, has its energy all in the form of gravitational-potential energy. The particle, A, has pressure-potential energy only, since it is at the level of the opening and is stationary. Particles, like C, passing through the opening have kinetic energy only, and it follows, from Bernoulli's Theorem, that the velocity of escape must be such that  $\frac{1}{2}dv^2 = dgh$ , that is, the kinetic energy of the escaping particle must equal the potential energy of the particle on the surface of the liquid, since each of these particles possesses energy of one kind only, and since the total energy for each particle is the same. This is the theorem of Torricelli. All other particles in the liquid, like the particle E, in the above discussion, have energy in each of the three forms indicated in the equation.

E. J. M.

**BERNSTEIN, HENRY** (1876- ), French playwright, was born at Paris, June 20, 1876. His first play, *Le Marché*, 1900, was produced in Paris, and was followed by *La Rafale*, *Le Détour*, *Le Voleur* and others which were successfully produced in translation in England and the United States. The latter, *The Thief*, is his most celebrated effort. Other well known plays are *Samson*, *Israël* and *Melo*. Bernstein's dramatic works are marked by technical skill in construction of plots and by bold execution and intense emotion.

**BERTHOLLET, CLAUDE LOUIS** (1748-1822), French theoretical chemist, was born at Talloire, in Savoy, Nov. 9, 1748. In 1781 he was elected to the Academy of Sciences and in 1798 was one of the scientists with Napoleon's Egyptian expedition. He made a notable study of dyeing, and with ANTOINE LAVOISIER, Berthollet promulgated a new chemical nomenclature. He investigated the nature of ammonia, chlorine and other chemical substances, studied physico-chemical relations, and suggested laws of chemical reactions and the theory of chemical affinity. He died at Arcueil, Nov. 7, 1822.

**BERTILLON, ALPHONSE** (1853-1914), French anthropologist, was born at Paris, Apr. 22, 1853. While head of the identification department of the prefecture of police at Paris, in 1882, he invented the system for the identification of criminals which bears his name. The method embraces anthropometric measurements and personal characteristics such as color of eyes, the thumb lines, scars, deformities and the like as a means of identification. It has been widely adopted by American institutions. Bertillon died at Paris, July 7, 1914.

**BERTILLONAGE.** In 1882 Alphonse Bertillon, a Frenchman, devised a series of eleven measurements for the identification of criminals. He had observed the fact that the combination of a given series of measurements was never the same in two individuals. Up to that time much difficulty had been experienced in ascertaining the identity of criminals. By this method a suspect might be definitely identified by his measurements. The French Government adopted this system, known as Bertillonage, with great success. Its use spread to other countries and was extensively



used until the recent adoption of the finger-print method of identification which is in certain respects more efficient and practical.

H. L. S.

**BERTILLON SYSTEM.** See BERTILLONAGE.

**BERTIN, LOUIS FRANÇOIS** (1766-1841), French journalist, called Bertin l'Aîné, was born in Paris, Dec. 14, 1766. He founded the famous French newspaper, *Journal des Débats*. Exiled in 1801, on his return in 1804, he again directed his newspaper, now renamed *Journal de l'Empire*. It was subsequently reestablished as a constitutional opposition organ, under its original name. Bertin died in Paris, Sept. 13, 1841.

**BERWICK**, a manufacturing borough of eastern Pennsylvania, on the Susquehanna River, 28 mi. southwest of Wilkes-Barre. It is served by the Pennsylvania and the Lackawanna railroads and motor bus lines. Industries include steel-rolling, planing and flour mills. The chief manufactured commodities are steel goods, food products, knitted goods and silk. The largest plant of the American Car and Foundry Company is here. Berwick was founded in 1772 by Evan Owen. Pop. 1920, 12,181; 1930, 12,660, about 5% foreign-born.

**BERWICK-UPON-TWEED**, a seaport, municipal borough, and county in itself, of England, 339 mi. northwest of London at the mouth of the Tweed. The picturesque town changed hands thirteen times in four centuries of Scottish border warfare, finally being ceded to England, 1482. The walls, dating from Edward I, were rebuilt in Elizabethan times, but there are no traces of ancient buildings, the famous castle having been razed for a railway station site. However, the town boasts a classic mid-century town hall with a bell tower that once rang alarm raids, and Holy Trinity Church, one of the few built in England during the Commonwealth. Once a considerable port, Berwick to-day still exports grain and coal, and has considerable fisheries. Pop. 1921, 12,985; 1931, 12,299.

**BERWYN**, a residential city of Cook Co., Ill., 9 mi. west of Chicago, situated on the Burlington and the Illinois Central railroads and accessible to the Cook County Forest Preserve. The retail trade in 1929 amounted to \$13,123,489. A rapid increase in population has brought about considerable building activity. The village of Berwyn was plotted in 1890 and became a city in 1908. Pop. 1920, 14,150; 1930, 47,027.

**BERYL**, a transparent gem mineral found as an accessory constituent in granitic and pegmatitic rocks in all parts of the world. Those of gem quality are sufficiently rare to make them semiprecious gems; the poorer qualities are common and crystals more than two tons in weight have been found in Massachusetts. In composition beryl is a beryllium aluminum silicate, crystallizing in the HEXAGONAL SYSTEM.

Several varieties of beryl are distinguished, according to their color. The presence of a small amount of chromium colors the mineral a bright green, producing one of the most valuable gems known, the EMERALD. The bluish green stones are called aqua-

marines, and the deep pink ones morganite. In addition there are colorless, apple-green, greenish yellow, yellow or "golden beryl," blue, violet and opaque brownish varieties.

Emeralds occur in mica Schists and clay slates. The only locality known to the ancients was Mount Zalora in upper Egypt, but they are now found in North Carolina, Colombia, Finland and Siberia. An AQUAMARINE weighing more than 18 pounds was found in Brazil; gigantic beryls of poor quality come from the New England States. Transparent beryls are found in Siberia, India and Brazil. See also PEGMATITE; PRECIOUS STONES; GEM STONES; HELIODOR.

**BERYLLIUM**, a metallic chemical element (symbol Be, at. wt. 9.02) belonging to the same group as magnesium. It occurs in a large number of minerals, notably BERYL—a variety of which is the precious stone, EMERALD—but few of these contain a high percentage of beryllium. Metallic beryllium is very light, the specific gravity being about 1.8, and has a higher melting point (1280° C.) than either magnesium or aluminum. Its alloys with aluminum and other metals are characterized by their lightness, strength, and hardness, and it is possible that in future a use may be found for them in airplane engines and the like, where lightness is of more importance than cost.

**BERZELIUS, JOHANN JACOB** (1779-1848), Swedish chemist, was born at Westerlosa, Aug. 29, 1779. Berzelius discovered solenium, thorium and cerium. He was the first to isolate calcium, barium, strontium, silicon and zirconium as elements, and he aided in the perfection of the atomic theory, the theory of radicals in component substances and of electrical association of chemical components, and the system of formulas now in use. He died at Stockholm, Aug. 7, 1848.

**BESANÇON**, a French industrial city and salt-springs resort, capital of the department of Doubs, situated on the Doubs River near the Jura Mountains, about 30 mi. southwest of Vesoul. A Roman colony, occupied by Julius Caesar and known as *Vesontio*, the city contains interesting relics of its Roman past. In medieval times Besançon was successively under German, Burgundian and Austro-Spanish rule; it was ceded to the French in 1678. The Cathedral of St. John, built chiefly in the 11th-14th centuries, has two apses; adjoining it is the Archbishop's Palace, built in the 18th century. The University of Besançon has faculties of science and letters, an observatory and an excellent library; in 1929 it enrolled 504 students. The chief local industry is watch-making, but the manufacture of artificial silk is also important. Besançon was the birthplace of Victor Hugo. Pop. 1931, 60,367.

**BESANT, ANNIE** (1847- ), née Wood, English theosophist and Indian Nationalist leader, was born at London, Oct. 1, 1847. She married the Rev. Frank Besant in 1867, but her conversion to the doctrine of free thought resulted in their separation. In 1877 she wrote a pamphlet, *The Fruits of Philosophy*,

which led to her arrest. Her theosophical beliefs and sociological theories have been widely circulated in pamphlet form by the Theosophical Society. Her longer works include *Ancient Wisdom*, *Esoteric Christianity*, *Future of Indian Politics* and *How India Fought for Freedom*, a story of the National Congress written from official records. She lectured for the first time in the United States in 1891 and has made many tours in this country and other parts of the world since. She was elected president of the Theosophical Society in 1907 and reelected 1914 and 1921. She founded the Central Hindu College at Benares in 1898 and the Central Hindu Girls' School of Benares in 1904 and helped to found the Hindu University. During the latter years of the World War, Mrs. Besant became associated with the Indian Home Rule movement and in 1917 was elected President of the Indian Nationalist Congress. Her extreme radicalism resulted in an open break with the party and she withdrew.

In 1926-27 as the patron of Krishnamoote she again traveled in the United States and on the Continent, proclaiming him the reincarnation of the great teacher and as the Messiah. After his return to India, Krishnamoote dissolved the Order of the Star and repudiated many of these claims.

**BESANT, SIR WALTER** (1836-1901), English novelist, was born at Portsmouth, Aug. 14, 1836, and was educated at Cambridge. He taught at the Royal University of Mauritius until forced by ill health to return to England. His first publication was *Studies in Early French Literature*, 1868. From 1871 he worked in collaboration with James Rice, and after the latter's death in 1882 continued to write short stories and novels. Besant was knighted in 1895. Among his best known works are *Ready Money Mortiboy*, 1872, *The Golden Butterfly*, 1876, *All Sorts and Conditions of Men*, 1882, *All in a Garden Fair*, 1883, *Dorothy Foster*, 1884, *Beyond the Dreams of Avarice*, 1895, and *The Alabaster Box*, 1900. He died in London, June 9, 1901.

**BESSARABIA**, a very fertile province of Greater Rumania lying between the rivers Pruth and Dniester on the Black Sea. It is the geographical threshold into the Danube Valley from Russia. Nearly all the invasions of Europe have passed through Bessarabia, and its population of 2,400,000 is very mixed, consisting of Russians, Rumanians, Poles, Greeks, Tartars, Turks, Armenians and Jews.

In the 16th century it became subject to the Turks; but in 1770, the Russians seized and held it till the CRIMEAN WAR, when the Congress of Paris, 1856, restored the southeastern part to Turkey. At the CONGRESS OF BERLIN, 1878, however, it was restored to Russia and it became an integral part of the Russian Empire till after the World War, when the Rumanians got it. For some years after its annexation by Rumania there was considerable difficulty with the Ruthenian part of the population.

**BESSEL'S FUNCTION**, a solution of the differential equation

$$\frac{d^2y}{dx^2} + \frac{1}{x} \cdot \frac{dy}{dx} + \left(1 - \frac{n^2}{x^2}\right)y = 0. \quad (1)$$

It was discovered in 1824 by F. W. Bessel (1784-1846) while investigating a problem in elliptic functions. Special cases of these functions had been considered by Daniel Bernoulli (1732) and by Euler (1781). The latter showed that Bernoulli's result is a solution of the differential equation

$$U \cdot \frac{d^2y}{du^2} + \frac{dy}{du} + y = 0,$$

which is a particular case of the equation

$$U \cdot \frac{d^2y}{du^2} + (n+1) \cdot \frac{dy}{du} + y = 0.$$

The latter may be easily transformed into Bessel's equation (1). In fact, claims have been made that at least in some cases there is an advantage in using solutions of this equation instead of Bessel's Functions.

J. G.

See A. Gray and G. B. Matthews, *Treatise on Bessel Functions*, 2nd edition, 1922.

**BESSEMER, SIR HENRY** (1813-98), English inventor and engineer, was born at Charlton, Hertfordshire, Jan. 19, 1813. He is chiefly celebrated for his steel manufacturing process which raised the annual production of steel in England from 50,000 tons a year to 1,600,000 tons, and reduced the price from 50 pounds to an average of ten pounds. The Bessemer process is widely used in the United States. Bessemer was knighted in 1879. He died at London, Mar. 14, 1898.

**BESSEMER**, a city of north central Alabama, in Jefferson Co., 12 mi. southwest of Birmingham. It has ample railroad and highway facilities. Its industries benefit from the extensive iron, coal and limestone deposits of the surrounding country and include iron and steel foundries, machine-shops, rolling-mills, blast furnaces, fertilizer, chemical, cement and soil pipe plants, lumber and saw-mills and brick-works. In 1929 the manufactures reached approximately \$9,000,000; the total retail trade amounted to \$9,499,410. Bessemer was founded in 1887, and incorporated in 1888; it was named in honor of Sir Henry Bessemer, inventor of the Bessemer process for manufacturing steel. Pop. 1920, 18,674; 1930, 20,721.

**BESSEMER STEEL**, steel produced by a process developed by Sir HENRY BESSEMER in 1856. The process comprises removing the non-ferrous constituents of molten pig-iron by oxidization with a blast of air, and subsequent addition of the elements required in the steel. The vessel or converter used consists of a pear-shaped steel shell, mounted on trunnions for tipping. The blast enters through tuyères in the bottom. As the air passes through the metal, the manganese, carbon, silicon and part of the iron are oxidized, the reaction producing enough heat to keep the metal in the molten state. When phosphorus is to be removed the converter is lined with a basic substance containing lime and magnesia, and lime is

added to the metal. A slag containing calcium phosphate is then produced. This is termed the basic Bessemer process, and the former, where the lining is of sand and clay, the ordinary or acid Bessemer process. *See also* IRON AND ITS ALLOYS.

**BESSEY, CHARLES EDWIN** (1845-1915), American botanist. He attended Michigan Agricultural College and Harvard University, later becoming professor of botany at Iowa Agricultural College in 1872, and at the University of Nebraska in 1884. He was a well known teacher of botany, and published many books as, *Botany for High Schools*, *Essentials of Botany*, *Plant Migration Studies*. Bessey was born at Milton, O., May 21, 1845 and died at Lincoln, Neb., Feb. 25, 1915.

**BESTIARY**, in the Middle Ages, a book of supposedly-natural history in which the alleged qualities of the animals described were allegorized to teach morals and religion. Bestiaries were very popular in Europe, and date back to the 2nd century B.C. One of the earliest was *Physiologus*, the Naturalist. The "natural science" of the bestiaries is worthless, but the legendary animals they described—unicorns, fire-eating panthers, basilisks—are a part of art and heraldry.

**BETA CENTAURI**, a star of the first magnitude and the second brightest star of the constellation CENTAURUS. It is one of the "pointers" of the Southern Cross, blue in color, 300 light years distant, and 3,000 times brighter than the sun. *See* STAR: *map*.

**BETA RAYS**, streams of high-speed ELECTRONS, called beta particles, which are spontaneously ejected from the nuclei (*see* NUCLEUS) of certain radioactive elements (*see* RADIOACTIVITY). All beta particles have a negative charge of  $4.77 \times 10^{-10}$  electrostatic units and a mass of  $9 \times 10^{-28}$  grams. Their velocities, as determined by deflections in magnetic fields, range between 29% and 95% of the velocity of LIGHT, i.e., between 50,000 and 180,000 mi. per sec. The rays from any one substance have, in addition to a wide continuous range of velocities, several outstanding groups of velocities characteristic of that substance.

As beta rays are easily deflected by MOLECULES of a gas through which they pass, they travel in extremely tortuous paths. They knock electrons out of the neutral gas molecules and thus create positively and negatively charged IONS. By observing the rate of production of these ions with an ELECTROSCOPE or ELECTROMETER, a measure is obtained of the number of beta particles being emitted and, hence, of the strength of the radioactive material. As ionizers, beta rays are roughly 100 times as effective as GAMMA RAYS and one one-hundredth as effective as ALPHA RAYS.

Beta rays are less easily absorbed than alpha rays and more easily absorbed than gamma rays. Three millimeters of lead will cut off all beta rays. They are capable of producing an image on a photographic plate which they strike. In most cases, those radioactive substances which emit beta rays also send out gamma rays at the same time. J. B. H.

**BETEL** (*Piper Betle*), a climbing shrub of the PEPPER family with large, thick, oblong leaves, na-

tive to the oriental tropics. Since ancient times the leaves have been chewed with the BETEL NUT as a narcotic stimulant by Malay peoples. The shrub is extensively cultivated in the East Indies.

**BETELGEUSE** (*Alpha Orionis*), a star of the first magnitude and the second brightest star of the constellation ORION, red in color and slightly fluctuating in brightness. Its name is a corruption of the Arabic *Ibt-al-Jauza*, meaning armpit of the giant. The first star for which the diameter was measured directly with the interferometer, Betelgeuse is about 290 times larger than the sun, some 250 million miles in diameter, and almost as large as the orbit of Mars. In luminosity it exceeds the sun 1,500 times. *See* STAR: *map*.

**BETEL NUT**, the nutlike seed of a graceful palm (*Areca Cathecu*) native to eastern Asia where it is extensively cultivated. The seed, which yields a dye and is used medicinally, is most important as the source of the masticatory betel nut chewed with betel leaves in enormous quantities by various Oriental peoples. For this purpose the seed, about the size of a small plum, is cut into slices, mixed with a little lime and rolled in a leaf of betel pepper. When chewed it turns the lips and saliva bright red and in time blackens the teeth. The mixture is hot and acrid but possesses aromatic and astringent properties and acts as a stimulant upon the digestive organs. In the Orient the production of betel nuts is of great commercial importance, the trade in the seeds exceeding \$30,000,000 yearly in India alone.

**BETHANY COLLEGE**, a coeducational institution at Bethany, W.Va., chartered in 1840. It is affiliated with the Disciples of Christ. The college has productive funds of \$1,852,750. The library contains 22,500 volumes. In 1931-32 the student enrollment was 349, and the faculty of 33 was headed by Pres. Cloyd Goodnight.

**BETHANY COLLEGE**, a coeducational institution at Lindsborg, Kan., founded in 1881. It began as an academy, and passed through the stages of a normal institute, until it attained college rank. The college is privately controlled and is under the auspices of the Swedish Lutheran Church. In 1931 the productive funds were \$387,778. The library contains 14,000 volumes. The student enrollment in 1931-32 numbered 475; the faculty of 36 was headed by Pres. F. Pihlblad.

**BETHLEHEM** (Hebrew for house of God), a small town in Palestine, situated about five miles south of Jerusalem. Its population in 1930 was 6,600, of whom 5,800 were Christians. The chief occupations are the raising of wheat, barley, olives and vines, and the manufacture of religious mementos. Bethlehem formed the Biblical home of David and his nephew Joab, and it is the traditional scene of the nativity of Jesus. The town was captured by the Crusaders in the 11th century and its holy sites have caused contention between Europe and Turkey.

**BETHLEHEM**, a city on the boundary of Northampton and Lehigh counties, eastern Pennsylvania.

It is situated on the Lehigh River and Canal, 56 mi. northwest of Philadelphia. Five railroads, motor buses, trolleys and an airport serve the city, which is on the William Penn and the Bethlehem Pike highways. The city is built on hills on both sides of the river, spanned at this point by three bridges, one of which, the Hill-to-Hill Bridge, was completed in 1924. Within the city is the main plant of the Bethlehem Steel Corporation, producing a vast quantity of steel and iron products, coke and coke by-products. Other companies are engaged in structural steel manufacture. Other industries include silk-milling, with an annual output worth about \$50,000,000, and the manufacture of cigars, furniture, hosiery and flour. The retail trade in 1929 reached a total of \$24,155,665.

Moravians, exiled from Moravia and Bohemia because of their convictions, came here in 1741. There is a Moravian College for women, which began as the first girls' boarding school in America, and a Moravian Theological Seminary. Bethlehem is also the seat of Lehigh University and Bishopthorpe Manor School.

The Moravians, lovers of music, organized the *Collegium Musicum*, later the Philharmonic Society, which was the first group to render Haydn's *Creation* in America. A Bach festival is an annual event.

Bethlehem became a borough in 1845 and combined with West Bethlehem in 1904. The city was incorporated in 1917, consolidating with South Bethlehem. Northampton Heights became part of the municipality in 1920. Pop. 1920, 50,358; 1930, 57,892.

**BETHLEHEMITES**, a military order of the Middle Ages, existent in the 13th century and dedicated to Our Lady of Bethlehem. Its symbol, reminiscent of Christmas, was a red star with five points and an azure center. In the 17th century Pedro de Betancourt founded an order of hospitalers, known as Bethlehemites, which devoted itself to the sick, to education and other tasks. In Guatemala and other Latin American countries were established Bethlehemite institutions which have suffered the suppressions generally applied to many religious orders.

**BETHLEN, STEPHAN, COUNT** (1874- ), Hungarian statesman, born Oct. 8, 1874. He became a member of the Diet in 1901 and at first allied himself with the Liberal party. Later, however, he took up the cause of Hungarian independence. At the end of the World War, he organized the conservative Magyar elements against the Red régime of Bela Kun. In 1921 he became president of the ministry, displaying great energy and skill in that position. It was under his leadership that the law for the exclusion of the Hapsburgs was passed in 1922, after he had been obliged to surrender King Charles upon that unfortunate monarch's second attempt to gain the throne. In 1927 Bethlen was successful in setting up a balance against the dominance of the Little Entente in southeastern Europe by an agreement with Italy. He resigned as premier on Aug. 19, 1931 after having served in this office for ten years.

**BETHMANN-HOLLWEG, THEOBALD VON** (1856-1921), German statesman, was born at Hohenjünow, Prussia, on Nov. 29, 1856. Having adopted the law profession, he was given successive government appointments until 1905, when he became minister of the interior. In 1907 he was made secretary of state for the domestic office of the empire, and in 1909 succeeded von Bülow as chancellor. He began by compromising with the Catholic party, and put into effect a new and more liberal constitution for Alsace-Lorraine. He was unsuccessful in dealing with the problem of suffrage in 1910, and also, although supported more strongly in the Reichstag by virtue of the elections of 1912, in attempting to settle the uprising in Alsace in 1913, when he was censured in the Reichstag. In 1914 he was notorious for his phrase concerning the Berlin guarantee as "a scrap of paper." In 1917, on account of the opposition of the Reichstag and the interference of Hindenburg and Ludendorff in his department, he resigned his office. In 1919 he published *Reflections on the World War*. He died on Jan. 1, 1921.

**BETROTHED, THE** (*I Promessi Sposi*), a historical romance of 17th century Italy by ALESSANDRO MANZONI; published 1825-27. Undoubtedly one of the world's greatest historical novels, this is the story of the love, struggling against obstacles and difficulties, of a nun, Gertrude, and her betrothed, the Un-named Knight. Of the numerous minor characters appearing in the book, the most important are Don Abbondio, the weak and very human priest who assists the lovers, and his opposite, the scrupulous unswerving Fra Cristoforo. The story proper is richly bound up with the life and history of the 17th century, a particularly notable episode being that of the Milan plague of 1631, and is further enriched by many sage reflections on humanity.

**BETSY BUG**, in Louisiana, the CORN ROOT WORM, known as the betsy bug. The same insect in the adult stage is known as the spotted cucumber beetle.

**BEUTHEN**, a German city, located in southeastern Upper Silesia. It is the center of the Upper Silesian coal and iron industry. There are many foundries in Beuthen and the adjacent districts. Beuthen is an important center for the transit trade between German and Polish Upper Silesia and for the transshipment of goods to Balkan countries. Originally a Bohemian fief, it passed through various hands and finally became Prussian. Pop. 1925, 86,881.

**BEVEL GEARS**. See GEARS AND GEARING.

**BEVERAGE PLANTS**, the various herbs, shrubs and trees yielding products, as leaves, seeds and roots, from which by infusion non-alcoholic beverages are made. Far outranking all others are the tea-shrub and the coffee-tree. Next in importance are the cacao-tree and mate or Paraguay tea. Of minor value are CHICORY, grown for its roots; the European milk-vetch whose seeds are known as Swedish coffee, and the catha shrub, cultivated in Arabia and tropical Africa. Under conditions of scarcity, parts of numerous other plants have been made to serve in place

of tea and coffee. Among the native plants which have been so utilized in the United States are the shrub called New Jersey tea and the Kentucky coffee-tree. See also TEA; COFFEE; COCOA.

**BEVERAGES**, a term including liquid foods, such as plain and fermented milks (see MILK) and FRUIT JUICES, alcoholic drinks made from molasses and malted grains, and water to which substances of different kinds have been added for flavor.

Beverages made of COCOA and CHOCOLATE have considerable nutritive value, both because of the large amount of fat which cocoa and chocolate themselves contain, and because they are usually made with milk and sugar, while COFFEE, TEA and MATE are water infusions of materials which have flavor and stimulating properties but no caloric value.

Fruit juices and beverages made from unfermented juices are refreshing and nutritious. The juice contains sugar and a large part of the minerals and vitamins (see VITAMINS IN FOODS) for which fruit is valuable. Orange, lemon and lime juice are especially rich in vitamin C. Grape juice and cider contain less of this vitamin than do the CITRUS FRUITS. Orange juice contains much less citric acid and more sugar than does lemon juice, hence it is less sour. Citric and other fruit acids are oxidized in the body to an alkaline residue which aids in maintaining the necessary supply of alkali in blood and tissue fluids. Cider is the juice of apples extracted from the crushed pulp. In "sweet cider" little or no fermentation has occurred, while "hard cider" is fermented until almost all of the sugar has been changed to alcohol and carbon dioxide, leaving a bitter flavor. Fermented sweet cider contains from 2 to 3% alcohol, while hard cider may contain 8% or more.

The term SOFT DRINKS includes non-alcoholic beverages in general, but especially carbonated and flavored beverages, such as ginger ale, soda water and pop, and non-carbonated beverages like cider and grape juice, and others having a natural or synthetic flavor.

Soda water is carbonated water, i.e., water charged with carbonic acid gas under pressure, flavored with sugar syrup, fruit juices, acids, artificial fruit essences and essential oils.

Alcoholic beverages include wines made of the fermented juice of fresh grapes, spirits such as brandy, gin, rum and whisky, distilled from fermented grape juice or from molasses or malted grains, liqueurs and cordials (spirits flavored with various aromatic substances), and beer made by the alcoholic fermentation by yeasts of malted barley and hops. H. T. B.

**BEVERIDGE, ALBERT JEREMIAH** (1862-1927), American statesman and historian, was born on a farm in Highland Co., Ohio, Oct. 6, 1862. After graduating in 1885 at Asbury College (now De Pauw University), he was admitted to the bar, and soon won reputation as a powerful and eloquent orator in law and in politics. From 1899 to 1911 he was U.S. Senator from Indiana. A staunch Republican, he vigorously defended McKinley's imperialistic policy towards the Philippines. During Roosevelt's

administration, he joined the group of "insurgent" Republicans, consistently supported reform legislation, and in 1906 put through the famous Meat Inspection Bill in the Senate. He became a leading figure in the short-lived Progressive party, and was chairman of its national convention in 1912. Although he subsequently manifested an active interest in politics, he turned to literature in his later years and won a high place among American historical writers. His most important work is the *Life of John Marshall*, in four volumes, published in 1916 and 1919, for which he was awarded the Roosevelt medal and the Pulitzer prize of 1919. Despite some serious omissions and inaccuracies, its many merits have earned it recognition as one of the finest American historical biographies. Hardly less important is his *Abraham Lincoln*, 1809-58, only two volumes of which were completed at the time of his death. Other works include *The Meaning of the Times* and *Americans of Today and Tomorrow*. He died at Indianapolis Apr. 17, 1927.

**BEVERLEY**, a municipal borough of the East Riding in Yorkshire, England, lying in level country near the Hull, about 189 mi. northwest of London. It boasts two remarkable churches. Beverley Minster, on a Saxon site, rivals many cathedrals, and magnificently blends the Early English and Decorated styles; St. Mary's is distinguished for particular purity of line. Cloth weaving was Beverley's chief medieval occupation, and a large agricultural trade later centered in the town. To-day, though eclipsed by Hull, 8 mi. northwest, it has breweries, chemical manufactures and tanneries. Pop. 1921, 13,469; 1931, 14,011.

**BEVERLY**, a city and port in Essex Co., northern Massachusetts, situated on the Beverly Harbor, 18 mi. northeast of Boston. Its 9-mi. seacoast forms part of the fine North Shore Drive, which connects the city with many summer resorts. Transportation facilities include the Boston and Maine Railroad, bus and ocean steamer lines and a municipal airport. Formerly a fishing and seafaring town, Beverly is now devoted to commerce and manufacturing. Shoe-making machinery and shoes lead among its numerous products. In 1929 the total factory output was worth about \$13,000,000; the retail trade amounted to \$10,697,778. Coal and oil are received and distributed here. The harbor commerce, consisting chiefly of these two commodities, in 1929 was valued at \$11,897,059.

Beverly equipped the first U.S. warship, which later captured the first British vessel taken during the Revolution, and, hence, is sometimes called the birthplace of the U.S. Navy. The first cotton mill in America was established here in 1788. Beverly instituted also America's first Sunday School. It was settled in 1626 and became a city in 1894. Pop. 1920, 22,561; 1930, 25,086.

**BEVERLY HILLS**, a suburb and residential city adjoining Los Angeles, in Los Angeles Co., southern California, situated 9 mi. from the Pacific Ocean. It is served by the Pacific Electric Railway. Beverly Hills is a community of luxurious homes, beautiful



avenues, parks, trees and shrubbery. It is noted as the home of many motion picture, theatrical and financial personages. The city was incorporated in 1914 and is under the control of a city council. A limited area is devoted to business; the only industrial plants are furnace factories and a planing mill. The retail trade in 1929 was valued at \$13,475,490. Beverly Boulevard passes the new branch of the University of California at Los Angeles and leads to Mandeville Canyon, the site of the California Botanic Gardens. Pop. 1920, 674; 1930, 17,429.

**BEWICK, THOMAS** (1753-1828), English wood-engraver, was born at Cherryburn House, near Newcastle-on-Tyne, Aug. 12, 1853. At the age of 17 he made the wood-cuts for Charles Hutton's book on mensuration. He illustrated *Gay's Fables* in 1779. In 1790 Bewick made the wood-cuts for a General History of British Quadrupeds. He also illustrated Oliver Goldsmith's *The Deserted Village* and *The Traveller*. He died at Gateshead, Nov. 8, 1828.

**BEXLEY**, a residential suburb of Columbus, O., in Franklin Co., situated on Alum Creek. Street car lines afford transportation to Columbus. Bexley is the seat of Capital University and St. Charles College. Pop. 1920, 1,342; 1930, 7,396.

**BEYLE, MARIE-HENRI.** See STENDHAL.

**BÉZIERS**, a city in the department of Hérault, southern France, about 20 mi. northeast of Narbonne. In the days of the Romans it was already celebrated as the center of a great wine trade. In the feudal age Béziers belonged to the viscounts of Carcassonne, and during the Albigensian Crusade in 1209 was captured by Simon de Montfort, with the massacre of some 20,000 of the inhabitants. The church of St. Nazaire, built in the 12th-14th centuries, is partly fortified and has a fine Gothic cloister. Pop. 1931, 71,527.

**BEZIQUE**, a two-handed card game, using two packs, from which the twos through the sixes have been eliminated. The ranking order is ace, ten, king, queen, knave, nine, eight and seven. Each player receives eight cards in threes and twos. The 17th is turned up for trumps, and the remainder form the stock. If the turned-up card is a seven-spot, the dealer scores seven. The non-dealer leads any card; but the second player does not have to follow suit, to win the trick, which is taken by the highest card. He may trump, even if he has cards of the suit led. In case of a tie, the leader takes the trick. Before the winner leads again, he must first draw a card from the stock, and the other player does likewise. Playing and drawing alternate until the stock is exhausted, tricks remaining face upwards.

Before the draw, the winner of a trick may declare certain combinations, by laying them face upwards on the table, separate from the tricks, and thereby making points for the winning score of 1,000. Class I declaration: the king and queen of any suit, called marriage, 20 points; the king and queen of trumps, royal marriage, 40, and a sequence of the highest 5 trumps, 250. Class II: the queen of spades and the

jack of diamonds, called bezique, 40, and two spade queens and diamond jacks, double bezique, 500 points. Class III: four aces, kings, queens and jacks, respectively, 100, 80, 60 and 40. Tricks containing an ace and ten, called a brisque, score 10; two aces or tens, or one of each, score 20. The player holding the seven of trumps gains 10 points by either declaring it and continuing to hold it in his hand, or exchanging it for the first card turned up. Declarations are made only at the player's will. Once a card is declared, it cannot be declared again in an equal or inferior combination of the same class, but can be part of a combination of a higher class. Therefore more than one declaration is possible to a trick, but only one score is put down at a time. The other is declared at the next trick. When the stock is exhausted, and the first card turned up has been played, the declared cards on the table are picked up and playing for the last eight tricks begins. Players must now follow suit and win the tricks, if possible. The winner of the last trick scores 10. If the winner scores 1,000 before his opponent makes 500, his score is doubled.

Rubicon bezique is played with four packs of 32 cards. Ordinary rules are subscribed to except that: 1. Nine cards are dealt to each player. 2. The first marriage determines the trump. 3. A hand without face cards, called carte blanche, scores 50 when declared. 4. Combinations broken in playing may be remade by substituting cards of the same class and declared a second time. 5. A game is complete in one hand. 6. Triple and quadruple bezique may be made, counting 1,500 and 4,500. 7. Brisques are counted only when the scores are very close.

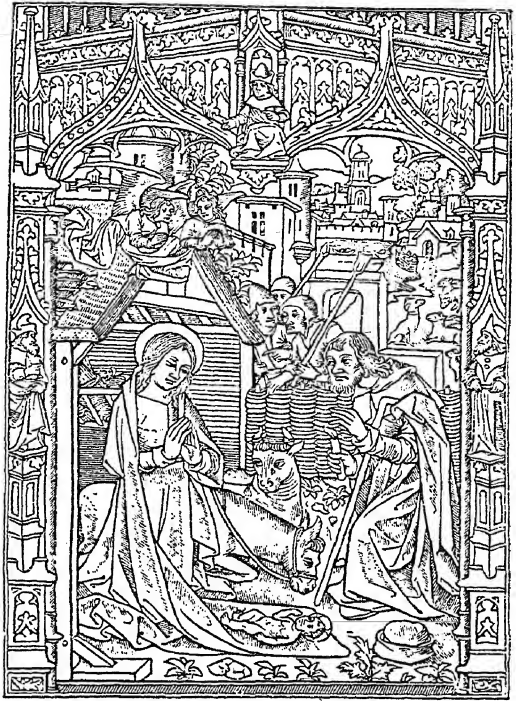
**BHAGALPUR**, the name of a city, district and division in the Behar section of Behar and Orissa, British India. The city, located on the Ganges River and served by the East Indian railroad, has a government silk institute and is the seat of the Tejnarayan Jubilee College. The narrow district of Bhagalpur, extending along both sides of the Ganges, is also traversed by the rivers Kosi and Ghagri. Its alluvial northern plains produce rice, wheat and maize. Area 4,226 sq. mi. The division of Bhagalpur includes the districts of Bhagalpur, Purnea, Monghyr, Darjeeling and the Santal Parganas. Area 18,613 sq. mi. Pop. 1921, city, 68,878; district, 2,033,770; division, 7,886,982; 1931, district, 2,237,804.

**BHATPARA**, a city in the district of the Twenty-Four Parganas, Bengal, British India, situated on the right bank of the River Hooghly, 22 mi. north of Calcutta. An attractive town, with several noteworthy public buildings, Bhatpara has some importance industrially and is also noted as a center of Sanskrit learning. Pop. 1921, 65,609.

**BHAUNAGAR** or **BHAVNAGAR**, a city and native state in the Kathiawar agency, Bombay, India. The city, founded in 1723 as capital of the state, is a seaport for smaller ships on the Gulf of Cambay; it is situated on the Bhavnagar-Gondal Railway. It manufactures tiles, has important iron and cotton mills, and trades extensively in cotton. The state of



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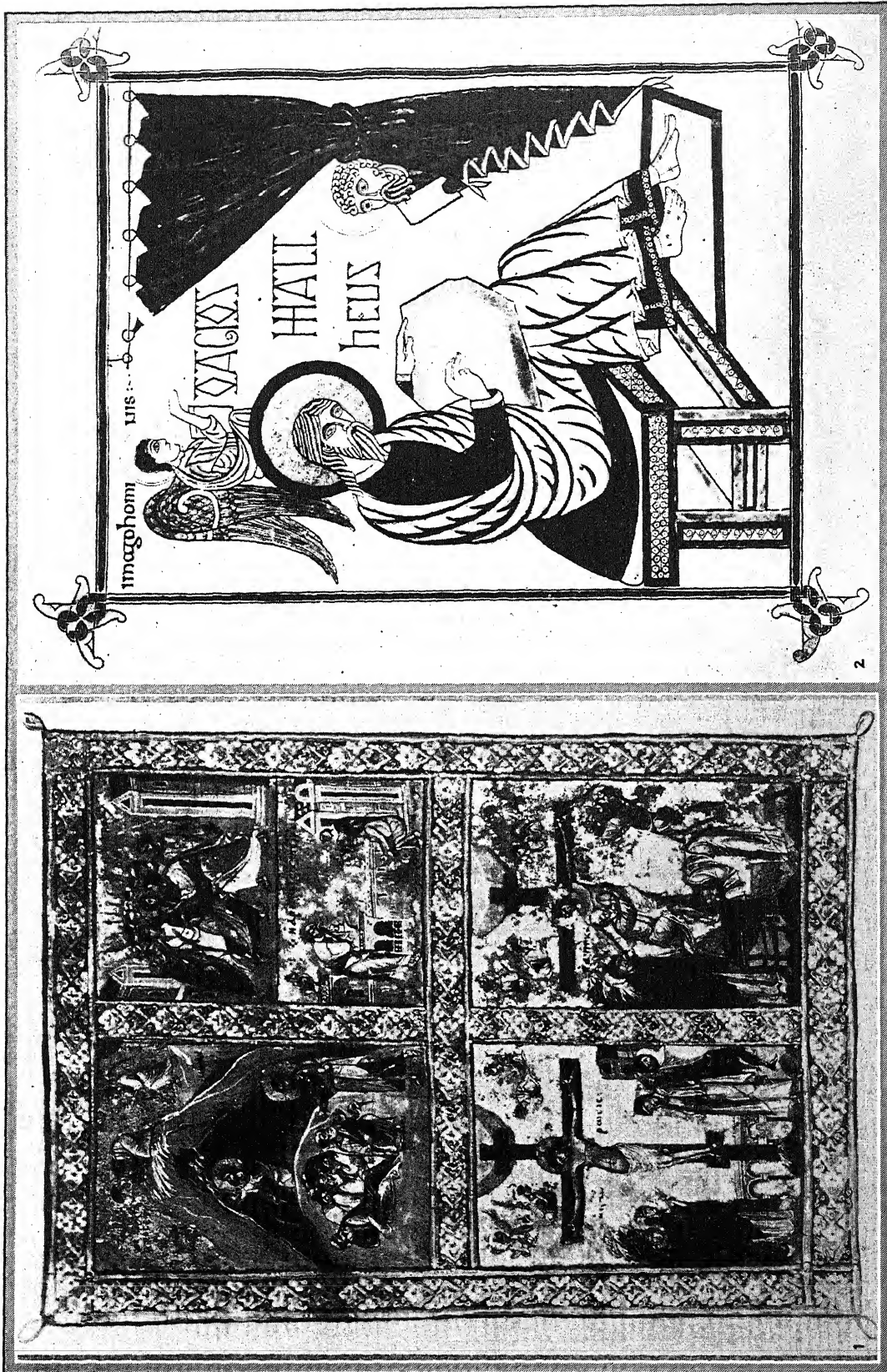


4

NEW TESTAMENT SCENES, FROM A FIFTEENTH CENTURY MISSAL

1. The Annunciation. 2. The Adoration of the Shepherds. 3. The Adoration of the Three Kings. 4. The Death of the Virgin. These relief cuts prob-

ably first appeared in the *Paris Missal* (*Missale adusum Ecclesiae Parisiensis*), printed by Ulrich Gering and B. Rembolt for Simon Vostre, Paris, 1497.



# ILLUSTRATED BIBLICAL MANUSCRIPTS

1. Four panels of an 11th Century Byzantine codex of the Gospel showing scenes from the life of Christ. Upper left, Christ on the Mount; Upper right, The Betrayal; Lower left, The Crucifixion; Lower right, Descent from the Cross.
2. Title page of Book of St. Matthew from the Lindisfarne Gospels, dating from about 700, in Latin text. Now in the British Museum.

Bhaunagar is well governed by a *thakor sahib*, head of the Gohel Rajputs of Kathiawar. Pop. 1921, city, 59,392; state, 426,404; 1931, state, 499,892.

**BHUTAN**, an independent state in the east of the Himalaya Mts., Asia, comprising an area of 17,000 sq. mi. and bordered on the north and east by Tibet, on the west by Chumbi and Sikkim and on the south by British India. It is a region about 200 mi. long and 100 mi. wide and is covered with lofty, forest-clad mountains. Punakha is the official capital. All the crops of temperate climates grow in Bhutan, but the chief exports are woolens, gold-dust, salt, silk, rice, India corn, millet, musk and horses. Elephants and ponies are raised. Manufactured articles include muzzle-loading guns and steel blades. There is a monastery, Tashichodzong, with 300 priests whose duties consist chiefly of reciting Tibetan scriptures and propitiating the evil spirits. At the head of the government is the Maharajah of Bhutan, a hereditary monarch who receives an annual subsidy from the British government as well as advice on the conduct of his foreign affairs, in exchange for which he promises good behavior. The population of Bhutan, estimated at about 300,000, is of the Buddhist religion.

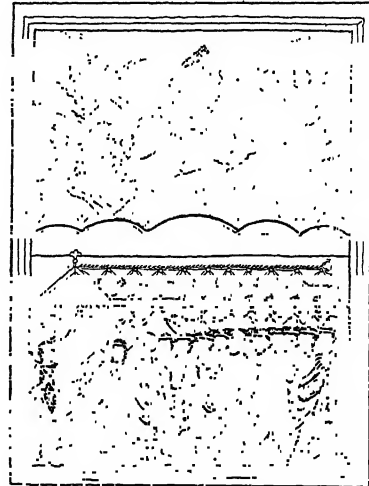
**BIALIK, CHAIM NACHMAN** (1873- ), Hebrew poet, was born at Radi, in southern Russia, in 1873, the son of an inn-keeper. He was educated in Radi and at the rabbinical seminary at Volozhin, and from there went to Odessa. The horrors of the Kishineff pogrom of Easter, 1903, inspired him to write *In the City of Slaughter*. This poem made him famous and also helped to inspire the Zionist movement. The poet became a partner in Odessa in a publishing firm which printed Hebrew literature; in 1921 when he escaped from Russia, he revived the firm in Berlin, and still later the press was transferred to Jaffa. Bialik is ranked as the greatest modern Hebrew poet. His *Poems*, 1924, and *Selected Poems*, 1926, have been published in English.

**BIALYSTOK**, capital of the Polish voievodship of the same name; situated south of the marshy valley of the Biala River, 85 mi. northeast of Warsaw. Until the second half of the 18th century Bialystok was a simple village. Its importance arose in 1749 when Prince Branicki built a magnificent palace in the Rococo style. In this palace is now located the office of the head of the voievodship. Bialystok is the principal manufacturing center of the northeastern section of Poland. It is an important railroad center and has good streets, a spacious market place and a large market house. Pop. 1921, 76,792.

**BIARRITZ**, a favorite watering-place in southwestern France, situated on the Bay of Biscay, department of Basses-Pyrénées, near the Spanish border. It traces its popularity to the visit in 1838 of Senorita Eugénie de Montijo, who continued to patronize Biarritz when she became Empress of France. The resort has a large English and American clientele. The climate is admirable throughout the year, and the scenery roundabout is magnificent. Biarritz is the center of

the Côte d'Argent with its silver breakers, and is the gateway to the Basque country. Pop. 1931, 22,955.

**BIBLE, THE**, sometimes called the Holy Scriptures or the Old and New Testaments, is the name given to the collective sacred writings of the Christian religion. The word Bible is derived from the Latin, *Biblia*, which is a transcription of a Greek word derived from the word *Byblus*, or papyrus, an Egyptian plant, the leaves of which were first used as material for ancient manuscripts. The word *Biblia*



ILLUSTRATIONS FROM THE BIBLE OF  
COUNT VIVIEN, A CAROLINGIAN MANU-  
SCRIPT OF THE MIDDLE 9TH CENTURY  
Bibliothèque Nationale, Paris

is plural in form, meaning little books, and is suggestive of the fact that the sacred literature is actually made up of a number of separate writings, by various authors and of different periods. The name was first used to designate the Holy Scriptures about 170, by St. Clement in his II Epistle 14:2. St. Jerome called the collection *Bibliotheca Divina*, the divine library.

**Canonical and Uncanonical Books.** The extent of the collection of books in the Bible turns on the questions relating to what is termed their canonical authority. The distinction between canonical and uncanonical books, if they are judged from their intrinsic character and value, appears to have been a fluctuating one. Not only does the canon of the Roman Catholic Bible, as confirmed by the Council of Trent, differ from that received by the Protestant churches; but the books excluded as uncanonical, sometimes termed *THE APOCRYPHA*, some of which have been known to the world as long as we have known of the canonical, and others of which have been discovered since, are in many instances of as definite value as some of the canonical books for the interpretation of religion and for the practice of the religious life. A comparison of four books known as Ecclesiastes, Daniel, Esther and the Songs of Solomon with several of the apocryphal writings is illustrative of this point. It is known that at the end of



the 2nd century A.D. the Jews accepted 24 books as canonical, which number, combining as it did certain books which are to-day separate, is identical with the 39 books of the Old Testament which the English Protestant Bible receives as canonical to-day. The Jews in Alexandria, Hellenized Jews, as they are sometimes called, had in their canon, called the "LXX" or the Septuagint, a Greek translation, the following books which to-day are included in the Bible used in the Roman Catholic churches: Tobias, Judith, Wisdom of Solomon, Ecclesiasticus, Baruch, I and II Maccabees and certain additions to the canonical books of Esther and Daniel. In this connection it is of interest to recall that the writers of the New Testament, when they quoted from the Old Testament, always quote from the Septuagint version, and consequently there exist in the canonical New Testament, as used by the Protestants, certain passages which belong to the so-called uncanonical books of the Old Testament, the uncanonical thus becoming canonical simply by quotation.

Tradition and the authority of the church have determined which books should be received as "the Word of God." The Roman Catholic Church is emphatic in its assertion that the Bible is "a collection of writings which the Church of God has solemnly recognized as inspired" and which contain "those revealed truths which the Holy Ghost wishes to be transmitted in writing." This Church holds that "the Primary Author is the Holy Ghost," and that the Church alone is the guardian and interpreter of what the Holy Ghost has caused to be written. In contrast to the position held by some of the early Protestants, that the Bible is the full and complete revelation of God, the Roman Catholic Church maintains that "all revealed truths are not contained in the Bible," and holds that other and additional revelations come through the Christian tradition from time to time.

What has been said of the books of the Old Testament may also be said of the books of the New Testament. In the 2nd century A.D. most of the 27 books of the New Testament had a wide recognition as holy and inspired; but for a long time there was doubt concerning the character of II and III Epistles of John, II Epistle of Peter, the Epistle of Jude, the Epistle of James, and the Revelation of John the Divine. On the other hand, several of the earliest lists of the New Testament books contain writings now listed in the New Testament Apocrypha, as for instance, the I and II Epistles of Clement, many of which are cherished by the Catholic churches as of great value.

**Translations of Original Text.** Our knowledge of the original text of the Bible as it appeared in the original languages of Hebrew, Chaldaic, or Aramaic, and Greek is dependent upon certain versions and translations which have come down to us in various manuscripts or parts of manuscripts preserved before the days of printing by many copyists. One of the principal versions in an ancient tongue was

that known as the Septuagint, our knowledge of which is obtained from extant versions made by copyists during the first Christian centuries and from quotations in the writings of early Christian authors. The first Latin translation, the Vulgate, was made by



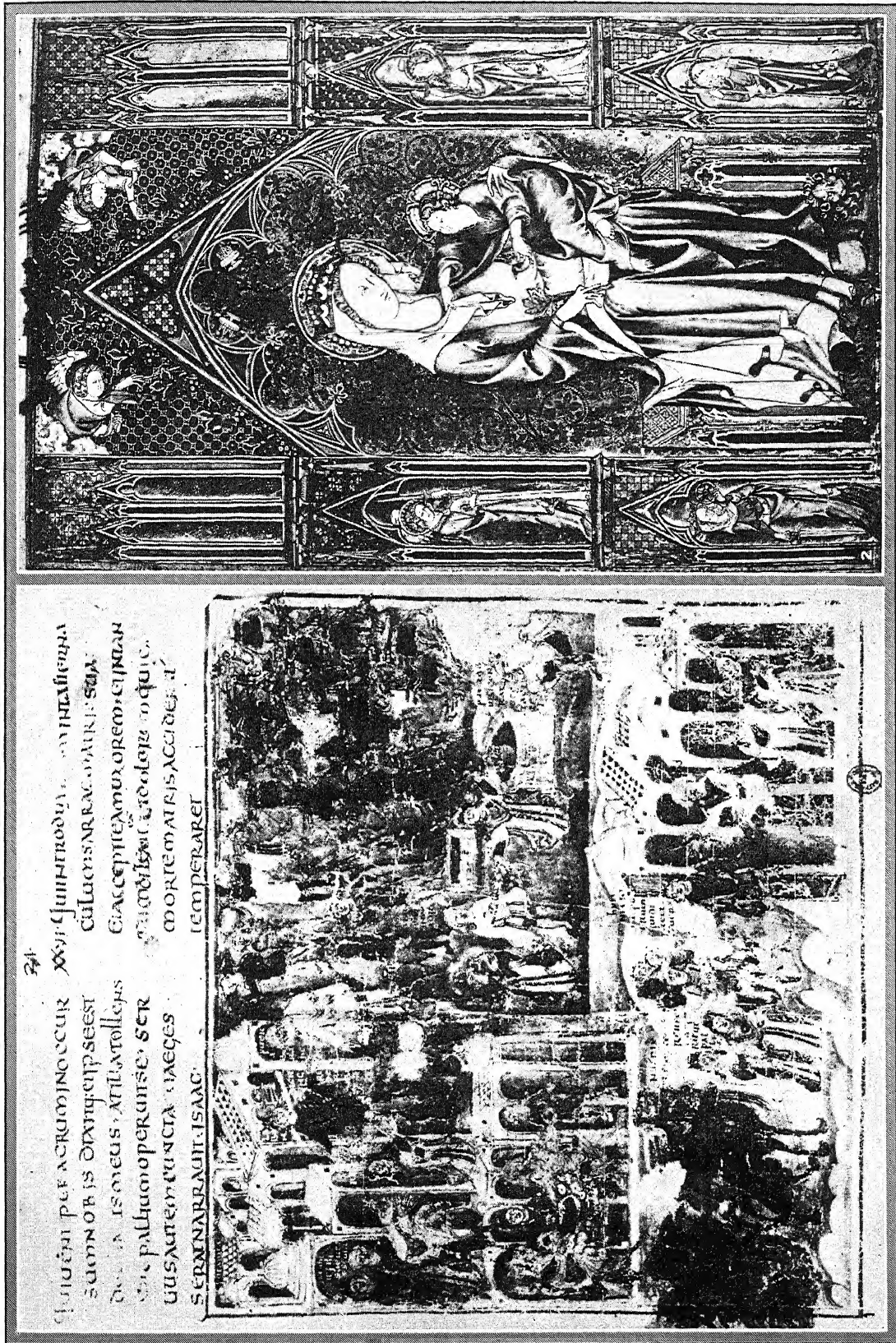
SECTION OF THE JOSHUA ROLL: THE ANGEL APPEARING TO JOSHUA

*A Byzantine manuscript of perhaps the 7th or 8th centuries, now in the Vatican Library*

St. Jerome at Bethlehem, Palestine, in 384, the revision of which was begun in 1908 by the Benedictines at the behest of Pope Pius X. The Egyptian or Sahadic version made from the Greek text belongs to about the same period. A Gothic version made by Ulfilas exists only in fragments, and is known at Upsala, Sweden, where it is kept, as "the silver Bible." The Armenian version and the Georgian version belong to the 5th century and are also from the Greek. The Slavonic version of St. Cyril and St. Methodias is a 9th century translation from the Hebrew and the Latin.

In addition to such versions in ancient tongues, there are many which exist in modern languages. The English translations first appeared in fragments and even in metrical form, such as those made by Caedmon, the Venerable Bede, and King Alfred. In 1382 JOHN WYCLIFFE gave the whole Bible in English based on the Latin Vulgate. In 1534 appeared Tyndale's translation from the Hebrew and Greek originals, written, not in Anglicized Latin, but in the English of the people. Miles Coverdale (1488-1568) finished his translation in 1535, borrowing heavily from the work of those before him. The Douai version of the New Testament was finished in 1582, and of the Old Testament in 1609 from the Vulgate. This became the standard Bible of the Roman Catholic Church in English-speaking lands. Before the appearance of the Authorized Version of King James I in 1611, there were others based in large measure on the work of Tyndale, such as the Great Bible of 1539-41, the Bishops' Bible of 1568 and 1572, and the Geneva version of 1560, the last being largely used by the translators of the King James version. The latter, or Authorized Version, was universally adopted by English-speaking peoples until the





## TWO RARE BIBLICAL MANUSCRIPTS

1. Page from the Ashburnham Pentateuch, a Spanish manuscript of the 7th century, in the Bibliothèque Nationale, Paris.
2. "The Madonna Enthroned," from the Arundel Psalter, formerly in the collection of Lord Thomas Arundel, now in the British Museum.

quoniam epistola sancti iheronimi ad  
paulinum presbiterum de omnibus  
diuine historie libris. capitulum primum.

**E**cce ambrosius  
tua michi nuntius  
ada pferens. terulic  
sit et suauissimas  
lras. q a principio  
amicicie. hic pba  
te iam fides et ueritas amicitie noua:  
pferbant. Quid tu illa necessitas e.  
et epi glutino copulata. qui non uidi  
tas rei familiaris. no pmo a carum  
corporis. no sibiola et palpas adula.  
sed dei timor. et diuinaru scripturarum  
studia conciliant. legimus in ueris  
historijs. quosdā sustulisse. puina as.  
nouos adijisse ppos. maria trasille.  
ut eos quos q libri nouerant. corā  
q uideret. Sicur piagoras metaphi  
nicos uates. sic plato regius. et archicā  
caratini. eandemq oram yralic. que  
quondā magna grecia dicebat. labo  
riosisime peraguit. et ut qui athenis  
nigr erat. et potans. cuiusq doctrinas  
achadenic gignalia psonabāt. fieret  
pgrus atq discipulus. malos aliena  
uocūde discere. qm sua ipudē ingre.  
Ducitq cū tras quasi roto ore fugien  
tes psequit. capr a piratis et uerida  
tus. orāno crudelissimo paruit. dud  
capitulus uind. et secus. Tame quia  
phus maior enate se fuit. ad orum  
suiū. latus eloquēte fonte manantē.  
de ultimis hispanie galliarūq finibz.  
quosdam uenisse nobiles legimus. et  
quos ad contemplationē sui roma nō  
traxerat. um? hois fama pduxit. Ha  
buit illa etas inaudiri omibz seculis.  
celebrandūq miraculū. ut urbē tantā

ingressi. aliud cū urbem quercant.  
Apolloni? fuit ille mag? ut uulgus  
loquatur. fuit phius. ut pitagora tra  
dunt. intrauit pfas. pñsiuit caualū.  
albando. scythas. mallagras. opulē  
tissima iudie regna penetravit. et ad  
egreum lacu phryson ampuē  
cū nullo puenit ad braguanas. ut  
hyarcam in throno sedne auro et de  
caualū fonte potantem. inter paucos  
discipulos. de natura. de moribz. ac de  
curfu dicit. et fides audire docerunt.  
Ite p clauinas. babilonios. thalte  
ros. medos. assyrios. parthos. syro  
pharices. arabes. palestinos. uisus  
ad allegandriā. petegit ad ethiopiā.  
ut gignosophistas et famolissimū  
solis mensam uidere in sabulo. An  
uenit ille uir ubiq q discere. et semp  
proficiēs. semp se melior fieret. Scrip  
sit super hoc plenissime odo uolun  
tibus. phylotatus.

**U**id loquar de seculi hominibus.  
cū aplus paulus. uas electōm.  
et magister gentiū. qui de consuetudine  
cū se hospitiis loquebat. dices. An  
appetimentū queris eius qui in me  
loquit xpi. Post damasū arabiaq  
lustrata. alcedit iherosolimā ut uidet  
petrū et māsire apud eū diebz quādam.  
Hoc cū misit ebdomadus et ogdo.  
adibz. tunc? gentiū pdicato. instru  
tus erat. Cursūq post ānos ppetu  
decim assumpto barnaba et orro. ego  
fuit cū aphs euāgdiū. ne fone in ua  
uum curaret aut curuisset. Habet  
nescio q latentis energie. uir uocis  
actus. et in aures discipuli de audoria  
ore transusa. sonus sonat. Quid et  
ethiopus cū rodi regular. et logetur

so-called Revised Version was published in 1881 and 1885. The committee of revisers had the cooperation of an American advisory board, which in 1901 issued an American Revised Version containing the readings which the Americans preferred, but which were not incorporated in the English Revised Version.

This brief history of the growth of the English Bible is illustrative of the history of the Bible in other European languages. In Germany between 1466 and 1521, there were 18 editions of the entire Bible, the earliest, that of Mantel, issued at Strassburg in 1466, and based as were all the others, on the Latin Vulgate. Luther began his famous translation from the original languages into the language of the German people in 1517, and it appeared complete in 1534. Soon after the scholars of the Roman Catholic church issued editions to limit and counteract the influence of Luther's Bible, the most notable of these being the Cologne Bible of 1630 and 1632. The Mazarin Bible, so-called, is an edition printed by Gutenberg at Mainz, 1450-55, which was the first book to be printed with movable types. It was called the Mazarin Bible because the first known copy was found in 1760 in the Mazarin Library in Paris. A copy was recently sold to the Library of Congress. The record of Bible versions for the Dutch, French, Italian, Spanish, Portuguese, Greek, Magyar, Lithuanian, the Slavic and Scandinavian languages is similar to that given for the English and the German.

The first English Bible to be printed in America was issued from Philadelphia in 1782. With the growth of foreign missionary activities during the last two centuries, the number of translations has increased enormously, so that to-day it is known that the Holy Scriptures in whole or in part can be found in over 400 languages and dialects. It is estimated that over 700,000,000 Bibles, Testaments and portions of the Bible have to date been issued by the various Bible societies, and each year the report of its sales shows a greater "best seller" record than any other book in any language.

**Literary Contents of Bible.** The literary contents of the Bible are diverse. The dominant theme is religion, and like all the best literature of the East, the language, both in prose and poetry, is vivid with picturesque images which have become the literary inheritance of all languages into which the Bible has been translated. It contains lyrics, laments, parables, philosophical dialogues, proverbs, tales, biographies, prayers, histories, legends, letters, fables, apocalyptic visions, sermons, poems, love songs, war hymns and legislation. It combines both realism and idealism, and according to the latest research, comprises the literary production of the Hebrew people and the early Christians over a period of a little more than a thousand years. Some of the songs and proverbs of the Old Testament date as early as 1200 B.C., while its latest writings close about 200 years before Christ. The writings of the New Testament are usually placed between 50 and 150 A.D.

The original literary form of the Bible as it ap-

pears in the early manuscripts differs from that which we know to-day. It was divided into chapters by Lanfranc in the 11th century, and into verses by Stephens in 1551. The Revised English version of 1881 abandoned the chapter and verse division of the earlier version in favor of an arrangement in paragraphs, the numbering of the chapters and verses, however, being retained for the convenience of reference. The chapter headings and the ancient chronology introduced by Archbishop Ussher were both eliminated as being no part of the original manuscripts.

**Statistical Compilations.** Previous to the adoption of this modern form, the various verses, or texts, of the Bible were the subject of much statistical and even superstitious research. Fortunes were told or the "will of God" was learned by the haphazard discovery of Scripture passages. Many went to the enormous labor of counting the verses, words and even the letters of the words, as if some magic were contained in the result. The following is a typical example of one of these compilations, made by Dr. Horne over a period of three years of his life. According to his reckoning, the Authorized Version of the Bible contains:

	<i>Old Testament</i>	<i>New Testament</i>	<i>Total</i>
Books .....	39	27	66
Chapters .....	929	260	1,189
Verses .....	33,214	7,959	31,173
Words .....	593,493	181,253	773,746
Letters .....	2,728,100	838,380	3,566,480

This form of literal research has also brought to light the following miscellaneous information: the word "and" occurs 46,227 times; the word "Lord," 1,855 times; "reverend," but once, "girl," but once; "everlasting fire" but twice; there are no words in the Bible of more than six syllables. Such students of the letter of the Bible inform us that the middle book is that of Proverbs; the middle chapter Job 39; the middle verse, II Chronicles 20:17; the middle line, II Chronicles 4:16; that the longest verse is Esther 8:9, and the shortest, "Jesus wept," in John 11:35.

**Authorship of Bible.** For the first 1,500 years of Christian history the traditions of the Jews and the early Christians were very generally accepted regarding the date, origin and authorship of the various books of the Bible. Devotion to the letter led at times to bibliolatry when "plenary inspiration," "proof-texts" and "the human pen of the Holy Spirit" were the phrases with which to conjure. In the train of the disputes which this view of the Bible engendered, came wars, slavery, religious persecution, the hanging of witches, polygamy and a systematic prostration of reason, all of which men tried to justify from isolated passages from the Bible. In such matters, Protestant bibliolatry was sometimes more abject than the Catholic, because, with the emphasis placed on the authority of the Bible by the Protestant Reformation, the interpreting power of the Church was denied.

The new position given to the Bible by the Protestant Reformation, however, led to a more intensive

and scientific study of its contents, and methods of interpretation and criticism came slowly to be recognized by all churches as the keys to the correct understanding of the Holy Book. Scholars in Germany, England, Scotland, Italy, Austria, Holland, Scandinavia and the United States began to devote their lives to the task of providing a sound foundation for a religious faith in a critical and scientific age. In this work Jews and Catholics were active as well as Protestants. The discovery of new manuscripts, recovery of original texts, studies into the social conditions of the early races which are mentioned in the Bible, excavations of biblical sites, and research into the writings of authors who were contemporary with the authors of Scripture have all combined to throw new light on the date and authorship of the Bible. A new study of the writings of Philo (c. 20 B.C.-50 A.D.) for example, was one of the earliest causes of fresh interpretation of the Old Testament. From this study grew the belief that the so-called Mosaic writings were possibly composite in authorship, and Jewish scholars from the days of Philo down to those of Spinoza in the late 17th century confirmed the theory.

The history of the interpretation of the Bible naturally goes back to the first Christian centuries, and it is usual to divide the record into four periods, (1) the Patristic, (2) the Medieval, (3) the Reformation, and (4) the Modern period. In the Patristic period, representing about 600 years, we have the opinions of men like Clement of Rome, Justin Martyr, Clement of Alexandria, Origen, Ephraem Syrus, Theodore of Mopsuestia, Tertullian and Cyprian, who fought out the dialectical battles of allegorical and literal interpretation. The second period, from the days of the Venerable Bede to those of Martin Luther, or from the 3rd to the 16th centuries, is rather barren in biblical research, but, with the full blossoming of the Renaissance, the revived interest in ancient languages awakened new study of the ancient manuscripts which enshrined those languages. With the appearance of the Lutheran Reformation, side by side with an emphasis on the mechanical and literal interpretation, a broader spiritual interpretation arose, and the decrees of the Council of Trent, 1545-1563, added church traditions to the Scriptures, including books known as deuterocanonical as sources of the Church's faith, till the day dawned when churchmen could proclaim that the Bible contained not *the* Revelation, but *a* revelation of God, an indirect recognition that the living soul is the origin of all sacred writings.

**Modern Views of the Bible.** During the last two centuries students of the Bible have learned to place the books of the Bible into strata periods, some parts of a book in one stratum and some in another. These strata can be classified somewhat as follows: (1) early fragments, imbedded like fossils in the later books; (2) prophetic writings, which are found in the books of the prophets and the earlier histories; (3) priestly writings, made two or three centuries later, during

and after the captivity of the Jews in Babylon, and covering laws, the later histories and the Psalms; (4) wisdom writings and apocalypses, some of which are in the canonical Bible of the Protestants and some in the Apocrypha, and finally (5) the New Testament stratum, of which the first to be written was the epistolary sections and the last the Gospels. The work is still progressing and after greater study and the modification of some of the first radical theories, a more vital understanding of the Bible may arise for the comfort and inspiration of all peoples.

These modern views, which first became widely recognized in the 18th century, are based fundamentally on the dictum early expressed by Semler (1725-91) that, to be interpreted rightly, every part of the Bible must be considered not only in its literal and grammatical sense but in the light of the historical surroundings in which it was written. The Higher Criticism, as this method came to be called, is essentially historical in its methods of interpretation. The connection between a book and the national history that produces the book is the master key that reveals the book's meaning. This method leads scholars to ascertain as accurately as possible when each book was written, who wrote it, and why it was written, with the result that, while the modern Bible is unchanged so far as its contents go, views concerning the authorship, date and purpose of those contents have changed considerably. The Bible has come to be viewed in this light as the normal product of man's spiritual nature, of his reason, imagination, conscience and feeling, and as a story of progress in religion and ethics. It is the spiritual autobiography of a race for more than a thousand years, its very crudeness in parts being a mark of its sincerity and trustworthiness.

**BIBLE SOCIETIES**, non-profit-making religious organizations engaged in translating, printing and distributing the Bible or portions thereof. The founding of Bible societies throughout the Christian world was a work mainly of the 19th century, though organizations which translated, printed and circulated Bibles had existed before that time. In Great Britain the first Bible society, founded in 1804, was the British and Foreign Bible Society. This society, with over 10,000 branches and auxiliaries at home and abroad, has continued to be the most important British organization of its kind. In Scotland the principal organization is the National Bible Society, founded in 1861, and incorporating the Edinburgh Bible Society, established in 1809, and the Glasgow Bible Society, founded in 1812. The outstanding society in Ireland is the Hibernian Bible Society, organized in 1806. In France the *Société biblique de France*, founded in 1864, is preeminent. Germany has four important societies: the Canstein Bible Society, at Halle; the Prussian Bible Society, at Berlin; the Württemberg Bible Institute, at Stuttgart, and the Berg Bible Society, at Elberfeld.

The first Bible society in the United States was founded in 1808 at Philadelphia. This was followed



by numerous state and local societies. In 1816 the American Bible Society was founded; it is an interdenominational organization of which most of the local and denominational societies have become auxiliaries. The American Bible Society distributes the Holy Scriptures without notes or comments in practically all parts of the world through its 12 foreign and 10 home agencies. Between 1816 and 1931 it translated the Bible or portions thereof into 309 languages or dialects, and during that period circulated 228,234,048 Bibles, Testaments and Portions, a Portion being a single book of the Bible. In 1930 alone the society distributed 12,035,133 Bibles, Testaments and Portions. Its appropriations in 1931 amounted to \$1,276,125. Also of importance in the United States is the Gideon Society, founded in 1899 at Janesville, Wis. Its purpose is to distribute the Bible among travelers, which it does chiefly by placing Bibles in hotel guest rooms.

**BIBLIOMANCY**, deciding fate or enterprises by opening a Bible to a page and selecting a passage by chance; then interpreting it to apply to the issue under consideration. It is an old-time favorite form of *DRY-NATION* by pricking for texts.

**BI-CAMERAL SYSTEM**, a system of legislative organization in which the legislature is divided into two separate chambers. Arising out of the stratified society of the Middle Ages, it was defended by *MONTESQUIEU* as necessary for the preservation of liberty, and an integral part of the system of checks and balances. Modern defenders insist that the bi-cameral system of legislative organization prevents hasty and ill-advised legislative action by virtue of the compulsory review of the work of each house the existence of a second chamber necessitates. They also maintain that it prevents the possibility of legislative tyranny, since the mutual jealousies of the leaders of the two houses can be depended upon to make difficult if not impossible action of such character, that it prevents corruption since it is more difficult to corrupt two houses than one and finally that it is a convenient means of giving representation to special interests.

S. C. W.

**BICARBONATE**, a term used to designate the monobasic salts of carbonic acid,  $H_2CO_3$ , the chief member of which is *SODIUM BICARBONATE*, commonly known as bicarbonate of soda. See also *CARBONATES* AND *BICARBONATES*.

**BICHAT, MARIE FRANÇOIS XAVIER** (1771-1802), French anatomist, was born at Thoirette, Nov. 14, 1771. He studied anatomy and surgery in Paris, but was forced to withdraw by the revolution of 1793. He later became a pupil of Desault, whose *Journal de Chirurgie* he completed after the author's death. He then wrote *Oeuvres chirurgicales de Desault*, 1798-99, setting forth and developing Desault's ideas. He also gave courses of lectures on anatomy, surgery and physiology. He was meantime appointed physician to the Hôtel-Dieu, where he had opportunity to study the pathological changes in the body caused by disease in an extensive series of autopsies.

His *Anatomie générale*, 1801, and *Anatomie descriptive*, 1801-03, illustrate the depth of his researches. He died at Paris, July 22, 1802.

**BICHROMATES**. See *CHROMATES* AND *DICHROMATES*.

**BICKNELL**, a city in Knox Co., southwestern Indiana, 75 mi. northeast of Evansville. Buses and the Pennsylvania Railroad afford transportation. Bicknell is an agricultural community in a grain-growing region. Coal is found in the vicinity. Bicknell was settled in 1868; incorporated in 1911. Pop. 1920, 7,635; 1930, 5,212.

**BICYCLE**, a light, two-wheeled vehicle propelled by the feet. Following the introduction, about 1890, of the "safety" type, bicycles came into very extensive use in Europe and America. But with the advent of the automobile the bicycle greatly declined in popularity in the United States; the total value of bicycles manufactured in 1923 was only \$10,726,900 and for 1929 it had decreased to \$6,183,773.

**BIDDEFORD**, a city of York Co., southwestern Maine, situated on the Saco River, about 5 mi. from its mouth and 15 mi. west of Portland. It is served by the Boston and Maine Railroad and bus lines. Biddeford is the market center of the county. Water power is abundant. The city's manufacturing establishments produce cotton goods, cotton mill machinery, shoes and lumber. In 1929 the manufactured output was valued at \$14,244,177. In 1929 the retail business amounted to \$7,814,381. Scenery in the vicinity is picturesque, and the summer resort Biddeford Pool is situated about 7 mi. down the river.

Capt. Richard Vines, an English explorer, settled at the mouth of the Saco in 1616, and in 1630 took possession of a grant including the present site of Biddeford. The settlement was originally called *Saco*, an Indian name meaning Big Pine; in 1718 it was renamed Biddeford, after an English town. It became a city in 1855. Many Indian wars, beginning in 1675, were fought in this neighborhood. Several memorials of the Revolution and the War of 1812 bear witness to historic local events, including a visit from Lafayette. About one-third of the present inhabitants are French-Canadians. Pop. 1920, 18,008; 1930, 17,633.

**BIDDLE, JOHN** (1615-62), writer and founder of English Unitarianism, was born at Wotton-under-edge, Gloucestershire, Jan. 14, 1615. His religious views were severely criticized by the authorities and he was imprisoned a number of times. *Twelve Arguments*, published 1645, and *A Confession of Faith Touching the Holy Trinity*, 1648, were among his writings pronounced heretical. Biddle died in prison Sept. 22, 1662. See also *UNITARIANISM*.

**BIDDLE, NICHOLAS** (1786-1844), American financier, was born at Philadelphia, Pa., Jan. 8, 1786. He was admitted to the bar in 1809, and served for a short time as a member of the Pennsylvania house of representatives. Biddle wrote a *History of the Expedition of Captains Lewis and Clark* from the oral statements of Clark. In 1814 he entered the state



senate, and while there initiated measures for the defense of Philadelphia against the British. He took part in securing a charter for the second **BANK OF THE UNITED STATES** in 1816, becoming president in 1823. When Congress refused to renew the charter of the bank, he continued as president of the substitute *Bank of the United States of Pennsylvania*. Biddle was one of the first advocates of the modern economic doctrine of shorter hours and higher wages for workers. He died at Philadelphia, Feb. 27, 1844.

**BIDEFORD**, a seaport and market town on the northern coast of Devonshire, England. It is 30 mi. northwest of Exeter, and is built on hills which rise from the sides of the Torridge River. The local manufactures are leather, earthenware, ropes and sails; lumber and coal are exported to Wales and Ireland. Pop. 1931, 8,782.

**BIEL**, a city of Switzerland, in the canton of Bern. It is picturesque with its Rathaus, fountains and medieval buildings. It has a technological institute, and the Museum Schwab, with prehistoric lake dwellings, relics of the glacial period, Celtic and Roman weapons, utensils and coins is noteworthy. Mentioned in 1141, the city has a large watch industry. Biel was the property of the Bishop of Basel and was incorporated with the canton of Bern in 1815. Pop. 1930, 37,861.

**BIELA, WILHELM BARON VON** (1782-1856), German astronomer, was born at Rossau, Germany, Mar. 19, 1782. In addition to his astronomical work he was a soldier. Of the three comets which he discovered, one sighted in 1826 with an unusually short period is named after him. He died at Venice, Feb. 18, 1856.

**BIELEFELD**, a Prussian city on the north side of the Teutoberg Forest. It is the center of the Westphalian linen-weaving and flax-spinning industry, and has textile mills which produce hosiery, plush and silk. Other industries include automobile, furniture, sewing machine and bicycle factories and paper mills. There is a modern Rathaus and theater. The old fortress of Sparenberg is in the neighborhood. Bielefeld became a member of the Hanseatic League at the close of the 13th century; it came into the power of the Great Elector in 1647. Pop. 1925, 86,062.

**BIENNIALS**, in botany, plants which normally complete their life cycle (from seed to seed) in two years and then die. During the first year a biennial is usually occupied only with vegetative activities, storing up food in its root, stem or leaves. In the second year the plant flowers and consumes its stored material in maturing fruit and seeds. After seed production the plant perishes. Although, in comparison with the immense number of annuals and perennials, there are but few biennials, various important economic plants are found among them. The beet, cabbage, carrot, celery, parsley, parsnip, turnip and onion belong in the biennial class, which includes also the snapdragon, hollyhock, foxglove and other garden ornamentals.

**BIERCE, AMBROSE GWINETT** (1842-1914?), American journalist and writer, was born at Horse

Cave Creek, O., June 24, 1842. He served with distinction in the Civil War. While working in the mint in San Francisco he contributed sketches and humorous paragraphs to the weeklies. His caustic wit and satire brought him recognition and he became columnist on the San Francisco *Examiner*. For a time Bierce lived in England, doing editorial work and contributing to English and French periodicals. His best known works are *The Fiend's Delight*, 1873, *Cobwebs from an Empty Skull*, *In the Midst of Life* and *Can Such Things Be?*, published 1893. His *Black Beetles in Amber*, a book of verse, was published in 1892. In 1913 Bierce settled his affairs and disappeared into Mexico. It is thought that he was killed during the Mexican Revolution of 1914.

**BIERSTADT, ALBERT** (1830-1902), American landscape painter, was born at Solingen, Germany, Jan. 7, 1830, and was brought to the United States in childhood. His pictures of the Rocky Mountains made him popular. Well known among Bierstadt's works are *Estes Park*, *Colorado Sierra*, *Nevada*, *Valley of the Yosemite* and *The Settlement of California*. The artist died at New York City, Feb. 18, 1902.

**BIFOCAL LENSES**. See **SPECTACLE LENSES**.

**BIGAMY**. See **POLYGyny**.

**BIG DIPPER**, or Great Bear, a large northern constellation. See **URSA MAJOR**; **STAR: map**.

**BIGELOW, JOHN** (1817-1911), American diplomat and writer, was born at Bristol, N.Y., Nov. 25, 1817. He was graduated from Union College, Schenectady, N.Y. In 1844 **WILLIAM CULLEN BRYANT** invited him to share the editorship of the New York *Evening Post*. In 1861 Bigelow was appointed United States Consul-General in Paris. Four years later he was made Minister to France. He wrote the life of Benjamin Franklin and edited his works in a 10-volume edition. A posthumous collection of Bigelow's works, entitled *Toleration, and Other Essays and Studies*, was published in 1926. Bigelow died Dec. 19, 1911.

**BIGELOW, POULTNEY** (1855- ), American journalist, was born in New York City, Sept. 10, 1855. He graduated at Yale in 1879. He made an intense study of colonial administration in tropical latitudes, lectured on this subject at universities and wrote several books. During the Spanish-American War Bigelow served as correspondent on the London *Times*. Subsequently he was editor of *Outing* and correspondent for *Harper's Weekly*. In 1925 Bigelow published *Seventy Summers*.

**BIG GAME HUNTING**, the pursuit of the larger animals for sport. Every continent offers some type of large animal, although Australia has only imported deer, and South America is of little interest to the sportsman. In North America, wapiti, mis-called elk; moose; caribou; bighorn; deer; bear, and puma are still found, according to the locality. In spite of generations of hunters there is good deer hunting in the eastern states. The West still offers deer, bear, wild goat and wapiti. Quebec and New Brunswick in eastern Canada and Manitoba in the west are famed

for deer, moose, caribou, bear and other big game. In Europe, big game is almost all on private estates. There are still vast tracts in the Caucasus Mts. which have not been touched by hunters, but political conditions and the savage inhabitants make them difficult of access. Scandinavia and Spain offer most hunting to the ordinary sportsman.

Africa, however, is the big game hunter's paradise, and probably will continue to be, since the protection of various animals has been started in time to prevent extermination. Here are antelope, notably the sable, roan and wildebeest; gazelles; leopards; rhinoceros; hippopotamus; buffalo; giraffe; elephants and lions. Asia rivals Africa in the variety of big game; but in many countries, especially in India, local potentates do not welcome white hunters. Deer, including the fine sambhar of India; antelope, especially the black buck; goats; sheep; boar; buffalo; rhinoceros; elephants; leopards and tigers are all well represented in Asia.

Among the methods of hunting big game are stalking, driving with beaters or dogs, mounted on horse or elephant, and night stands on pathways or with bait. Perhaps the most difficult animals to bag are the various wild sheep and goats of the Himalayas and Rocky Mts., and proud indeed may be the sportsman who can show the head of *Ovis Poli* or *Ovis Ammon* (wild sheep), or the ibex and markhor (wild goats of the Himalayas), or the American bighorn. For large and dangerous game, such as elephants, lions, buffalo, tigers and panthers, a double barrel rifle is better than a repeater, since it is quicker to pull a second trigger than to shift a shell from magazine to barrel. Not many years ago rifles of enormous caliber, the equivalent of from .600 to .750, were used for such game. To-day, the largest caliber rifle is commonly the .470, using smokeless powder and either soft nose or jacketed bullets, depending on the quarry. As a matter of fact the 250-3000 high power rifle or the .303 are large enough for any North American game and for almost any other except elephants and rhinoceros. For big game, the cost of hunting licenses runs from \$50 for a non-resident in the United States and \$100 in Manitoba, to \$500 in one section of Africa.

**BIG HOLE BATTLEFIELD**, a national monument in western Montana, approximately 90 mi. south of Missoula on U.S. Interstate Highway No. 93. A tract of 5 acres was set aside June 23, 1910 under the administration of the War Department to preserve the site of a battle fought Aug. 9, 1877 between a small force of United States troops and a much larger band of Nez Perce Indians. The battle resulted in a complete rout of the Indians.

**BIGHORN**, called also Rocky Mountain sheep (*Ovis canadensis*), the finest hoofed game animal of North America. A full-grown head is a prize for which sportsmen travel thousands of miles and endure incredible exertions. Wary, bold, hardy, keen-eyed and difficult to approach, when pursued the bighorn takes to the topmost summits of the surrounding country and, if cornered, plunges down steep precipices to

escape unhurt. A large ram stands about 42 in. at the shoulder and weighs about 350 lbs. with spectacular curving horns, which in a fine specimen measure 18 in. in circumference at the base. The female, which has small horns, bears one or two young in the spring.



BIGHORN OR ROCKY MOUNTAIN SHEEP

Bighorns are found in the western mountain ranges of the United States from northern Mexico to British Columbia. A smaller species, the white mountain sheep (*Ovis dalli*), is found in Alaska and Yukon territory. In the United States, the bighorn is now rigorously protected.

**BIG HORN HOT SPRINGS PARK**, a state park, established in 1897, located in Hot Springs Co., northwestern Wyoming, near Thermopolis; area 1 sq. mi. Water from four large and hundreds of small mineral springs supplies numerous lakes and falls and is also used for medical treatments.

**BIG HORN RIVER**, a stream located in Wyoming and Montana, formed by the union of the Popo Agie and Wind rivers in Fremont Co., Wyoming. Its chief headstream, the Wind River, has its source in the Shoshone Mountains in western Wyoming. The Big Horn flows almost straight north through the Big Horn Mountains into Montana, and after crossing the Crow Indian Reservation, empties into the Yellowstone River at the eastern border of Yellowstone Co. It is about 450 mi. long and with its many tributaries, including the Shoshone, Greybull and Little Big Horn rivers, drains an area estimated at 20,000 sq. mi. The region traversed is mostly mountainous and noted for its magnificent scenery. The Big Horn is navigable as far as Fort Custer at its junction with the Little Big Horn River. The Wyoming cities of Thermopolis, Worland and Greybull are located on its course.

**BIGHT**, a broad and shallow bay, or recess, in a coastline between distant headlands. The Great Bight of Australia indents the south shore in a long, gradual curve, connecting headlands which lie, as the crow flies, about 700 miles apart. African examples are the Bight of Biafra, and the Bight of Benim, forming depressions in the shore of the Gulf of Guinea, near the mouth of the River Niger.

**BIG SPRING**, a city in western Texas, the county seat of Howard Co., 78 mi. northwest of San Angelo, served by the Texas and Pacific Railroad. The city

is a trade center for the oil-fields of the vicinity, and a shipping market for live stock and farm crops. The railroad maintains offices, round-houses and shops. In 1929 the retail trade amounted to \$6,993,636. Big Spring is the seat of a United States Government agricultural experiment station. There are salt deposits beneath the city. The city was so named because of the large spring in the vicinity. Pop. 1920, 4,273; 1930, 13,735.

**BIG TREES.** The largest tree known, when height and massiveness are both considered, is the California big tree (*Sequoia gigantea*). This attains a height of 325 ft. with columnar trunks sometimes 225 ft. to the first limb and 30 ft. in diameter at 6 ft. above the ground. Of greater height but inferior massiveness is the California redwood (*S. sempervirens*), which sometimes grows 340 ft. high with a trunk 20 ft. in diameter. Some species of *Eucalyptus* attain enormous size, the largest officially recorded, a specimen of *E. regnans* on Mt. Baw near Melbourne, reaching a height of 326 ft. and a diameter of 8 ft. at 6 ft. above the ground. Various other trees sometimes attain immense girth but do not grow to a correspondingly great height. Among these are the BAOBAB, of Africa and the East Indies, occasionally 30 ft. in diameter at the base, and the giant CYPRESS (*Taxodium mexicanum*) of Mexico. A specimen of the latter, known as the big tree of Tule, measuring 154 ft. in girth 6 ft. above the ground, attains a height of only about 150 ft. The BANYAN, including its accessory system of prop roots or supplementary trunks, shades a larger area than any other tree. See also EUCALYPTUS; SEQUOIA.

**BIHAR** or **BEHAR**, a division of the province of Bihar and ORISSA of British India. It has an area of 42,360 sq. mi. and consists of the eastern portion of the Gangetic valley that lies between the lower spurs of the Himalayas on the north and the Chota Nagpur plateau on the south. Rice growing is the principal occupation of the inhabitants. The region was a part of the ancient kingdom of Magadha. It was the cradle of Buddhism and still has many Buddhist remains. The Mahomedans captured Bihar in 1193, and in 1397 it became part of the kingdom of Jai-pur. In 1765 the EAST INDIA COMPANY took possession and the province was united with BENGAL, from which it was taken in 1912 to become a portion of the province of Bihar and Orissa. Pop. 1921, 23,380,288; 1931, 26,650,917.

**BILAC, OLAVO BRAZ MARTINS DOS GUIMARAES** (1865-1918), Spanish-American poet, known as "the prince of Brazilian poets." A voluptuary of feeling, of charm, of form, of language, of taste, Bilac toward the end of his life became a much more social spirit than his predominantly Parnassian esthetics would have seemed to prophesy. His printed works consist largely of speeches and criticism, but it is his poetry, first issued in 1888, that won for him the unique distinction he enjoyed as an unparalleled virtuoso of expression. The collection upon which his fame rests is but a book of average size, consist-

ing of the following divisions: *Panoplias* (*Panoplies*), *Via Lactea* (*The Milky Way*), *Sarças de Fogo* (*Fire-Brambles*), *Alma Inquieta* (*Restless Soul*), *As Viagens* (*Voyages*), and *O Caçador de Esmeraldas* (*The Emerald-Hunter*). The original edition ended with the *Fire-Brambles*.

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**BILBAO**, a city of Spain, capital of the province of Vizcaya (Biscay), divided into the old and new city and situated on the River Nervion. Large deposits of iron ore are nearby and there are iron and steel works, foundries and shipbuilding. Sea-going vessels enter the harbor; exports include iron ore, pig iron, steel, wire and wool. Coal, coke and codfish are imported. The city was built in 1300 on the site of the old Flaviobriga; was twice captured by the French and besieged in the Carlist wars. Est. pop. 1929, 160,501.

**BILBERRY**, the name given to several low shrubs of the heath family, yielding edible berries. The bog bilberry (*Vaccinium uliginosum*), found from the northern United States to the arctic regions and also in Europe, bears small dull leaves and black berries. The dwarf bilberry (*V. cespitosum*), found widely on mountains, has smooth shining leaves and blue berries.

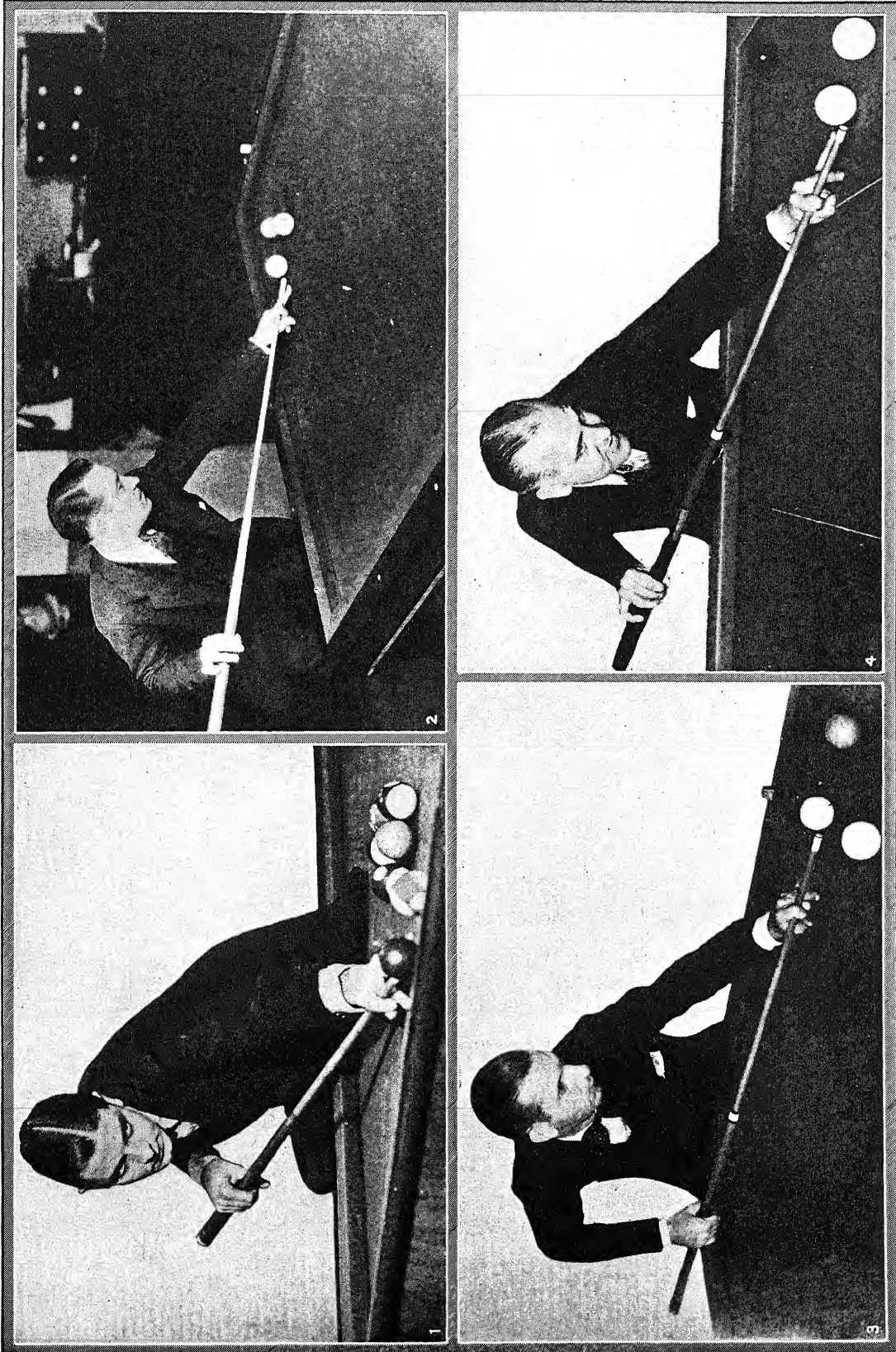
**BILE.** Functions of, and derangements of bile secretion. See JAUNDICE.

**BILGE**, the curved part of a vessel's hull that connects the bottom with the vertical sides. The curve may have a small radius, in which case the ship is said to have a hard bilge, or it may have a large radius, in which case she has an easy bilge. To prevent excessive rolling of a vessel, bilge keels consisting of angles and plates are riveted to the outside of the hull at the bilge.

**BILHARZIASIS**, also called schistosomiasis, a tropical parasitic disease produced by a blood fluke which lives in the visceral veins of man and other mammals. Three species infect man: *Schistosoma haematobium*, the Egyptian blood fluke, abundant in the Nile Valley and certain other limited areas in Africa, Asia Minor, Europe and Australia; *S. mansoni*, rare in Southern Egypt, common in Central Africa, occurring also in the southern United States, West Indies and South America; and *S. japonicum* in the Far East (China, Japan, Formosa and the Philippines). Unlike almost all other flukes (Trematoda), the schistosomes are of separate sexes. The oval eggs hatch in water and the free-swimming embryos bore into snails, producing in the snail liver a new generation. This emerges as cercariae which swarm in snail-infested ponds and ditches. They penetrate the skin of bathers; thus the common people are generally and heavily infected. Such waters piped into houses in Egypt and used for bathing bring about the infection of the better classes.

In man the worms migrate to the portal and mesenteric veins, where they mature. The females produce immense numbers of eggs, which break out from the veins into the bladder or intestine. Ex-

# BILLIARDS



COURTESY BRUNSWICK-BALKE-COLLENDER CO.

## WORLD'S GREATEST BILLIARD PLAYERS

1. Ralph Greenleaf, ten times holder of world's pocket billiard championship.
2. Jake Schaefer, holder of world's 18-2 balk line billiard championship.
3. Arthur Thurnblad, three-cushion billiard champion of the world.
4. Willie Hoppe, probably the greatest all-around billiard player.





cessive thickening of the walls, tumors, ulcers, and bloody urine characterize forms of the disease. Ancient hieratic medical writings describe the disease, and mummies of the Pharaohs give further evidence of its presence in Egypt in earliest times. The disease has of late been successfully treated by a course of intravenous injections of tartar emetic if the patient is an adult. If the patient is a child, the more costly emetine is preferred. H. B. WA.

**BILLBOARDS**, a popular term meaning outdoor ADVERTISING by means of painted, printed or lithographed bulletins and posters. In the United States this form of advertising is highly organized. Standard-sized poster panels, durably and artistically constructed, are located at carefully selected spots. For a given city the advertiser may buy a full showing, which guarantees him an intensive poster display, or a half showing which insures representative coverage. It is estimated that more than \$80,000,000 is spent yearly for the various forms of outdoor advertising. This form of advertising is still in disfavor with many people but higher ethical standards enforced by public opinion and the various advertising organizations are gradually leading to improved conditions.

**BILLBUG**, the popular name for any species of large snout-beetles of the subfamily *Calandrininae*, some of which are very injurious to corn. These winter as adults, feeding on young corn in the spring. Eggs are laid in cavities in stems of host plants; the larvae are borers in the stems and pupate in the ground about midsummer. Some species feed by preference on sedges and bulbous-rooted grasses, but subsist on corn if these are destroyed. Others attack sugar cane and wheat. Control measures consist in destruction of rushes and sedges, in rotation of corn land, and in planting crops free from infestation near newly cleared ground.

**BILLERICA**, a town including North Billerica, a woolen mill village in Middlesex Co., northeastern Massachusetts. It is situated about 7 mi. south of Lowell and is served by the Boston and Maine Railroad. Mitchell School is situated just southwest of the village. The town was set off from Cambridge in 1652 and incorporated in 1655. Pop. 1920, 3,646; 1930, 5,880.

**BILLET**, the name given to a bar or slab of iron or other metal, especially when forged from an ingot. When iron or steel is being produced for stock, the hot ingots are generally rolled into slabs several feet in length. These are then cut into lengths or billets.

**BILLIARDS**, a game played on a table with small balls and cues. There is evidence that the Greeks played billiards about 400 B.C., and there are some who maintain that billiards was played by the Egyptians hundreds of years before the Christian Era. The French played billiards during the reign of Louis XI, 1423-83. Other nations claim that their people were playing billiards long before France or England. Italy is mentioned as the birthplace by one author; another gives credit to Spain. And the Germans put in a claim. The Spaniards are credited with introducing

billiards into the United States in 1565, when a family from Spain arrived in the town that now is St. Augustine, Fla.

Ten centuries ago billiards was played outdoors. After it became an indoor game it was played with crude equipment, and it was not until the improved rubber cushions were discovered that billiards became a standardized game. The first championship billiard match in the United States was played in 1859, and Michael Phelan is credited with being the first recognized billiard champion. In those days, the game was played on a table, 6 feet by 12, with four pockets and four balls.

There are to-day three distinct styles of billiards: These are played on the carom table on which there are no pockets; the pocket billiard table in which a point is credited for each ball pocketed, and the English billiard table, 6 feet by 12, which has six pockets. In the latter game points, as well as balls pocketed, count for caroms. The carom style was accepted for the international game. Pocket billiards is played only in the United States, and English billiards in the British Empire. Straight rail and balkline, the carom table games, are played in the United States, France, Germany, Spain, Italy, Austria, Holland and Japan. Balkline has become the major international style of play, and for years world honors rested between the United States and France.

The famous American players were Old Jake Schaefer, Frank Ives, George Slosson, George Sutton, Willie Hoppe and Young Jake Schaefer. The noted French players were Maurice Vignaux and Louis Cure. Edouard Horemans is rated as the best Belgian cueist, and Eric Hagenlacher as the greatest German billiard player. Japan has produced Koji Yamada, Kinrey Matsuyama, a present world's title contender; K. Suzuki and Tadao Suganuma. In 1931 the recognized greatest players were: 18.2 balkline, Young Jake Schaefer; pocket billiards, Erwin Rudolph, New York; three-cushions, Arthur Thurnblad, Chicago; English billiards, Walter Lindrum, Australia. J. S. CA.

**BILL IN EQUITY**, the formal statement in writing of the claim of the PLAINTIFF in a suit in chancery. It is in the nature of a petition, stating the facts which are the basis of plaintiff's claim and praying that defendant be brought before the court and required to answer, and for equitable relief—i.e., such remedy or remedies as a court of equity can grant. Under modern codes of civil procedure or practice acts it is usually replaced by a COMPLAINT or STATEMENT OF CLAIM.

**BILLING MACHINES**, combination typewriters and calculating machines used in office work to write at one operation the several necessary copies of orders, invoices, bills of lading, etc., and to compute the amounts of the items and accumulate totals. Cut or continuous printed forms with interleaved carbon paper are used in the machines. Some billers are non-computing.

**BILLINGS, FRANK** (1854- ), American physician, was born in Highland, Wis., April 2, 1854.

He received the degree of M.D. at Northwestern University in 1881, and after studying abroad became successively demonstrator of anatomy, professor of physical diagnosis, and professor of medicine in his Alma Mater. In 1898 he became professor of medicine and in 1900 dean of the faculty at Rush Medical College, and, following the affiliation of that school with the University of Chicago, became professor of medicine at the university. He was chairman of the American Red Cross Mission to Russia in 1917, and served during the World War as Brigadier-General in the Medical Corps. His name is associated with the establishment of many national medical institutions, research organizations, and medical periodicals. He has been connected prominently with many of the leading medical organizations of the United States, and has been president of the American Medical Association (1902-1904), of American Physicians (1906), and of National Association for the Study and Prevention of Tuberculosis (1907). M. F.

**BILLINGS, JOHN SHAW** (1838-1913), American physician, was a native of Indiana and became distinguished as an army surgeon during the Civil War. In 1876 he originated the Index Catalogue of the Army Medical Library, which has been continued through three series since that time and which gave rise eventually to the Index Medicus and later to the Quarterly Cumulative Index Medicus. Doctor Billings became librarian of the New York Public Library, and through his efforts the library was developed to a high plane of efficiency. M. F.

**BILLINGS, JOSH.** See SHAW, HENRY WHEELER.

**BILLINGS, WILLIAM** (1746-1800), early American composer, was born at Boston, Mass., Oct. 7, 1746. Although uneducated, and a tanner by trade, he published six collections of hymn tunes. Their contrast to old Puritan sacred airs won wide popularity for his works. A fervent patriot, several of his compositions, included in *The Singing Master's Assistant*, were composed during the War of Independence, and became popular with New England troops. While his tunes were by no means technically perfect, his work is unique in that it was the first published music by a native American. He died at Boston, Sept. 26, 1800.

**BILLINGS**, a city in southeastern Montana, the county seat of Yellowstone Co., situated on the Yellowstone River, 200 mi. east of Butte. It is served by bus and truck lines, airplanes and three railroads. Oil and gas are found in this region. Billings has beet-sugar factories, and is a shipping point for a rich farming section, producing chiefly sugar beets, beans, wheat, live stock and dairy commodities. In 1929 the local factory output amounted to approximately \$5,000,000; the retail trade reached a total of \$13,629,432. It is the seat of Eastern Montana Normal School and Billings Polytechnic Institute. Pompey's Pillar, Custer's Battle Field, Beartooth National Forest, including Grasshopper Glacier, are points of interest in the vicinity. Billings was founded as a railroad town in 1882. Pop. 1920, 15,100; 1930, 16,380.

**BILLITON** or **BELITOENG**, an island of the Dutch East Indies, lying between Borneo and Sumatra. Billiton is somewhat square in shape, and covers an area of almost 1,900 sq. mi. The surface is generally low. The island is noted for the extensive tin deposits, but it also produces gum, timber, trepang, tortoise shells, wax, coconuts and sago. Administratively it forms an assistant residency of Sumatra. Pop. est., 1928, 71,276.

**BILL OF EXCEPTIONS**, a formal stating in writing of objections to the rulings of the trial judge taken during the trial of a case, setting forth the objections, the facts and circumstances on which it was founded, and a statement that the party tendering the bill excepted thereto. The purpose of the bill of exceptions is to put upon the record rulings of the trial court and the evidence upon which, or circumstances under which, the rulings were made where otherwise they would not be part of the record. At common law the bill is prepared by counsel, and by him tendered to be signed and sealed by the judge. In England judge's notes, taken by the judge during the trial, are used instead, and in the United States many jurisdictions appoint official stenographers and provide for transcribing and using stenographic notes in place of a formal bill of exceptions.

**BILL OF EXCHANGE**, according to the American Uniform Negotiable Instruments Law, adopted by many states, "an unconditional order in writing . . . signed by the person giving it, the drawer, requiring the person to whom it is addressed, the drawee, to pay on demand or at a fixed or determinable future time a sum certain in money to order or to bearer." This definition follows the English Law. The Continental law in this respect differs in certain details regarding wording, endorsement, days of grace, and so forth.

The bill of exchange is one of the oldest forms of credit instruments, traces of which have been found in Babylon, Egypt and Rome, and more clearly in Genoa and Florence. Originally a **PROMISSORY NOTE**, it developed about the 15th century into a draft accepted by the drawee. Today the term is used to include **CHECKS**, drafts, promissory notes, trade and **BANKERS' ACCEPTANCES**. The primacy of London as an international money market was based fundamentally upon the wide currency of the sterling bill of exchange or banker's acceptance and the rapid rise of New York after the World War to a position of prominence in the financing of foreign trade was due to the increased use of the dollar bill of exchange. See also **ACCEPTANCE**; **FOREIGN EXCHANGE**.

**BILL OF LADING**, the written evidence of a contract for the carriage and delivery of goods by a **CARRIER** at a certain freight rate. It should contain the names of the consignor and consignee, the name and signature of the carrier, the places of departure and destination, the price of the freight, the date of receipt by the carrier and a description of the articles shipped. (Uniform Bills of Lading Act, Section 2.) Other functions of the bill of lading are to acknowl-

edge receipt of the goods by the carrier, and when made to order of the consignor to act as document of title to the goods shipped and to serve as an instrument whereby consignor may obtain credit against payments to be made on or after delivery. Thus the bill of lading may serve four distinct purposes at once. In credit transactions it is security for payment of a draft or **BILL OF EXCHANGE** drawn by the consignor upon the consignee.

Originally the bill of lading was used to evidence shipment of goods by merchant vessels. With the development of freight transportation by railway, the bill of lading was adopted for shipments by rail and more recently for commercial transportation by motor truck.

**BILL OF PARTICULARS**, in law, a written statement specifying the items of the demand in an action at law, or the details of the alleged offense in an indictment or information in a criminal proceeding. The model code of criminal procedure of the American Law Institute recommends a short form indictment with a right on the part of the accused to call for a bill of particulars in case information as to details of the charge becomes important. This practice is likely to be generally adopted.

**BILL OF RIGHTS**, 1689, a historic assertion of freedom in England. After the flight of James II (*see* **REVOLUTION: ENGLAND**), a Parliamentary Convention drew up a Declaration of Rights, enumerating the liberties infringed by the former king. William and Mary accepted this declaration, which was passed by Parliament as a statute. Summarized the Bill of Rights was as follows: (1) It is illegal to suspend or dispense with the laws, (2) to set up a **HIGH COMMISSION COURT** or other arbitrary tribunal, (3) to levy money without a grant of Parliament and (4) to maintain a standing army in time of peace without the consent of Parliament. (5) Subjects have a right to petition the king. (6) Election of members of Parliament is to be free. (7) Freedom of debate in Parliament is not to be questioned. (8) Excessive fines must not be imposed, and, in cases of treason, jurors must be freeholders. (9) Parliaments must be held frequently. (10) William and Mary are declared sovereigns, and a Catholic, ineligible for the Crown. (*See* **PROTESTANT SUCCESSION**.) The Bill of Rights should be compared with the **DECLARATION OF INDEPENDENCE**, 1776, in which it was complained that the King had interfered with law and justice, and had "made Judges dependent on his will alone," also, that he had "kept among us in time of peace, Standing Armies, without the consent of our legislature."

**BILL OF RIGHTS**, U. S., popular name for the first 10 amendments to the Constitution of the United States. Several of the state conventions in ratifying the Constitution protested that individual liberties were not sufficiently safeguarded, and added desired amendments. Twelve of these were proposed to the states by Congress, 1788, and 10 promptly ratified. They guarantee the right of trial by jury, of due process of law in Federal procedure, and prohibit

cruel and unusual punishments; they restrain the National Government from interfering with the right of citizens to bear arms, to petition the Government to assemble peacefully and from abridging the freedom of speech or of the press, or the freedom of conscience. They are called the Bill of Rights from their analogy with the Act of Parliament, 1689, defining the political liberties of Englishmen.

**BILL OF SALE**, a written document whereby a seller transfers to a purchaser his right to or interest in goods or chattels. Usually the bill recites the names of the seller and purchaser, the date of the sale and a specific description of the goods or chattels being transferred. Although a bill of sale is not always necessary to the transfer of personal property interests, it is valuable evidence of ownership. In maritime law, change of ownership of a ship must generally be evidenced by a bill of sale. By act of Congress (Revised Statutes, Section 4170) sale of a registered ship to a citizen of the United States must always be accompanied by such a bill.

**INSTALLMENT BUYING** has brought into common use a bill of sale which is in the nature of a chattel mortgage. By this instrument the purchaser takes title conditionally upon payments being made according to the agreement contained in the bill of sale. In transactions of this type some states require that transfers of certain classes of goods, such as livestock and automobiles, be recorded by filing for public inspection the bills of sale covering the property involved.

**BILL OF SIGHT**. *See* **BILL OF EXCHANGE**.

**BILLROTH, THEODOR** (1829-1894), German surgeon, was born April 26, 1829, at Bergen on the island of Rügen. He is to-day recognized as one of the great pioneers in abdominal surgery. He served as professor of surgery in Zürich and Vienna. In 1863 he wrote a volume on surgery (*General Surgical Pathology and Therapeutics*) which was translated into most modern languages. Billroth performed many daring operations; he was the first to operate on the esophagus and the first to remove the pylorus of the stomach successfully for cancer; he was also the first to remove the larynx and have the patient recover. Billroth was a skilled amateur musician.

**BILL SIKES**, a criminal in Dickens's **OLIVER TWIST**. He kills his lover Nancy, and his troubled conscience makes him stumble while trying to escape over a roof and hang himself with the rope by which he was planning to slide down.

**BILOXI**, a numerically unimportant Siouan group, now extinct, which formerly lived in southern Mississippi. Like the northern Siouan tribes, they lived in tipis, dressed in breechcloth, leggings, moccasins and robes. They were fair potters, worked somewhat with wood, fashioned bowls and wove baskets. They possessed a complicated kinship system and reckoned descent maternally.

**BILOXI**, a city of Harrison Co., southern Mississippi, situated on the Gulf of Mexico, about 80 mi. northeast of New Orleans. The Louisville and Nash-

ville Railroad and bus lines afford transportation. Biloxi is an all-year resort, with various kinds of sport. The packing and shipping of sea food is the principal occupation. The total value of its manufactures in 1929 was \$2,942,074. In 1929 the retail trade reached a total of \$4,905,303. Biloxi was first fortified by the French in 1699. Since then seven flags have waved over the city, five of them national. Pop. 1920, 10,937; 1930, 14,850.

**BIMETALLISM**, the simultaneous employment of two metals, usually gold and silver, as the standard of the monetary system. This involves an official ratio of equivalence, the free coinage of both metals, and unlimited **LEGAL TENDER** of coins of either metal in the payment of debts, both public and private.

Bimetallism necessarily involves the selection of a rate at which the two metals shall be regarded as of equal value. Thus if the rate be 16 to 1, 16 ounces of silver would be minted into coins of the same face value as would one ounce of gold. Furthermore, the mints are open to the free coinage of either metal at this ratio, so that a person could bring any quantity of silver or of gold and have it coined into money on this basis. Debts may be paid in either kind of coin at the option of the debtor.

Bimetallism works satisfactorily only so long as the mint ratio conforms to the market values of the two metals. If the business world places the same value upon one ounce of gold as upon 16 ounces of silver, and the mint ratio corresponds to this 16 to 1 market ratio, no difficulty will ordinarily be encountered in maintaining bimetallism. However, if the market ratio should change, and become, for example, 17 to 1, it would be foolish for a person to take an ounce of gold to the mint when with that ounce he could go out into the market and buy 17 ounces of silver and with 16 of the ounces get the same number of dollars from the mint that he could with his ounce of gold. Under these circumstances the mint would receive plenty of silver, but very little or no gold. The mint would be over-valuing silver in its fixed ratio. Furthermore, gold coin would tend to be melted down and used to buy silver bullion, only part of which would have to be taken to the mint in order to replace the dollars used to purchase the silver. The country would thus tend to go onto a *de facto* silver standard.

On the other hand, if the market ratio should fall to 15 to 1, the mint, with its fixed ratio of 16 to 1, would be over-valuing gold and would consequently receive plenty of gold, but little or no silver. Silver would then tend to disappear from circulation, and the country would have a *de facto* gold standard.

The experience of history illustrates these principles and shows the difficulty of maintaining the bimetallic system. Countries endeavoring to have bimetallism have had first one metal as the standard, and then the other, according as the market ratio of gold and silver went up or down. The United States had a predominance of silver and practically no gold coin following the Mint Act of 1792 which gave this coun-

try legal bimetallism. As a result of changes in the mint ratio in 1834 and 1837 there followed a period in which gold money predominated and in which there was a scarcity of small change. The United States was finally forced to abandon bimetallism in 1853 when the subsidiary silver was made lightweight so that it would stay in circulation. Bimetallism continued legally until 1873.

France was successful in maintaining bimetallism for a relatively long period because of the fact that her mint ratio coincided with the market ratio, which remained fairly stable during this period.

During the latter part of the 19th century the principal countries of the world abandoned bimetallism in favor of gold **MONOMETALLISM**. The reduced demand for silver as a result of this was one of the factors which led to a cheapening of silver in terms of gold, so that the market ratio of the two metals departed widely from the relative stability that had existed for centuries.

The principal argument in favor of bimetallism is that it gives greater stability to the value of the currency than can exist under either the gold standard or silver standard, on the principle that two commodities when combined, are more stable than either one alone. It is also argued that if the principal countries of the world all had bimetallism and at a uniform ratio of gold to silver, the monetary demands for the metals would dominate their market value, so that the market ratio of the two metals would probably conform closely to the mint ratio. Bimetallism has never been tested under these conditions. See *also* **COINAGE**; **GOLD STANDARD**. J. P. Y.

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**BINARY CYCLE**, in power production, a system for converting heat to mechanical power by using two fluids in series instead of one, as in an ordinary steam **POWER PLANT**. The cycle of each fluid is similar to that of the water in the ordinary steam plant. As an example, consider the mercury-steam cycle. Coal, burned under a **BOILER** filled with liquid **MERCURY** (see **MERCURY VAPOR BOILER**) produces saturated mercury vapor at 880° F., and 70 pound gage pressure. This drives a mercury turbine. The mercury vapor exhausted by the turbine at one pound absolute pressure and at 445° F., passes to a mercury condenser which also serves as a steam boiler. Mercury, reliquified in the condenser, passes back by gravity to the mercury boiler. Steam, produced by heat passing from the condensing mercury to the water, is delivered to a **STEAM TURBINE** at 280 pound gage pressure, after being superheated to 735° F. The steam turbine by itself generates somewhat more power than that produced by the mercury turbine.

The total fuel required to generate a given amount of power is considerably reduced by this arrangement, a modern commercial plant having operated for long periods with a fuel consumption of only 0.71 pound of coal per kilowatt hour.

The binary cycle is a practical attempt to approach that theoretically-most-desirable power generating condition in which most of the heat is introduced to the cycle at the highest possible temperature. In an ordinary steam power plant the steam receives most of its heat at temperatures well below 600° F., even when operating at a pressure of 1,400 pounds.

Recent experiments in Germany and elsewhere indicate that the mercury-steam cycle may soon find an active competitor in various "binary chemical" cycles. In these, some loosely-bound chemical compound, without water, is fed to the boiler. There the heat of the fuel breaks the compound into a residual liquid and a high temperature vapor, usually AMMONIA gas. The vapor drives a turbine and later recombines with the liquid from which it was originally separated. This recombination gives off heat which produces steam to drive an ordinary steam turbine. P. W. S.

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**BINARY STARS**, two stars that are physically connected with each other. See **DOUBLE STARS**.

**BINDERS**, in agriculture, machines for harvesting grain. There are two general types, the grain binder, used for small grains such as wheat, barley and rye; and the corn binder, used to harvest such crops as Indian corn and cane. All binders consist essentially of cutting and binding mechanisms. The former severs the stalks a short distance above the ground and lays them parallel to each other on a platform. The binding mechanism assembles the stalks into bundles, and automatically ties twine around them.

Horse drawn binders are equipped with a large ground wheel which carries most of the weight and supplies power for operating the cutting and binding mechanisms; such binders may also be drawn with a tractor. Some grain binders are built for operation with tractor power only; in such machines, power to operate the cutting and binding mechanisms is supplied by the engine of the tractor and is transmitted to the binder in the form of rotary motion by means of a power take-off shaft.

Horse drawn grain binders cut a swath from five to seven ft. wide, and the tractor binder cuts one ten ft. wide. The corn binder harvests one row at a time.

A. J. S.

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**BINDWEED** (*Convolvulus sepium*), a handsome vine of the convolvulus family, called also hedge bindweed and wild morning glory, with showy varieties cultivated under the name of Rutland beauty. It grows widely throughout temperate regions, often becoming a pestiferous weed in moist soils. The slender stem, 3 to 10 ft. long, usually twining about the stalks of weeds or of crop plants, bears heart-shaped or hastate leaves and white, pink, or sometimes striped, bell-shaped flowers.

**BINET, ALFRED** (1857-1911), French psychologist, was born at Nice, France, July 8, 1857. He studied law and medicine and in 1871 went to Paris,

where he made researches in experimental and pathological psychology and was director of the psychology laboratory at the Sorbonne. With Thomas Simon he studied and experimented to create a standard by which the mental capacities of human beings could be measured, and in 1905 they published the Binet-Simon intelligence tests which have since been widely used in grading students in schools and colleges. Binet was one of the editors of *L'Année psychologique* and made many contributions to physiological psychology, chiefly in connection with the study of social and educational questions. He died at Paris, Oct. 18, 1911.

**BINGEN**, a town in Hesse, Germany, situated on the left bank of the Rhine River, 17 mi. from Mainz. Bingen is well known as a tourist center, as it is in a district rich in legends and has a famous whirlpool nearby, Roman remains and medieval castles. The town's industries are of minor importance, but there is considerable river traffic. Pop. 1925, 9,146.

**BINGHAMTON**, a city of southern New York, the county seat of Broome Co., situated on the northern fork of the Susquehanna River at its confluence with the Chenango River, about 50 mi. east of Elmira. The transportation facilities include three railroads, bus lines, the Bennett flying-field and the West Endicott Airport. Binghamton is located in the midst of picturesque country, which is largely given over to truck and dairy farming and potato crops. The most important local manufactures are shoes, cameras, films, washing machines, furniture and time clocks. The value of manufactured products in 1929 amounted to \$54,269,679. In 1929 the retail business amounted to \$52,869,729. The city has several fine parks, among them Ross Park with 100 acres and Ely Park with 134 acres.

The first settlement here, called Chenango Point, was made about 1787. In 1800 the town was laid out under its present name. Binghamton was granted a city charter in 1867. Pop. 1920, 66,800; 1930, 76,662.

**BINOCULAR INSTRUMENTS**, instruments in which the object may be viewed simultaneously by both eyes. In a few binocular instruments, with a single objective, such as one type of binocular Microscope, identical images are presented to the two eyes and there is no stereoscopic (see **STEREOSCOPE**) effect. For a true stereoscopic perception of depth, it is necessary that the two eyes view the object from two different points. The binocular instrument designed for this purpose generally consists of two complete monocular instruments so combined that the two eyes can be conveniently applied to the two eye-pieces. The image in a binocular instrument is always erect, and the better instruments are provided with adjustments by which the distance between the oculars can be altered to the observer's pupillary distance and by which one half of the instrument can be focused independently of the other to compensate for differences in the accommodation of the right and left eyes.

A binocular instrument composed of two microscopes is a binocular microscope. Such instruments



are generally of low or medium magnification and are particularly convenient for observation in dissecting work or other delicate operations. The most common binocular instrument consists of two small TELESCOPES and is referred to briefly as a binocular. On the basis of optical design, these are classified as prism and Galilean-type binoculars. In the prism binocular, the image is erected by a PRISM system which enables a large field of view and a magnified stereoscopic effect to be obtained. In the Galilean type each half is a Galilean telescope which gives an erect image without the use of prisms. Its field of view is much smaller than that of the prism instrument. However, it is lighter in weight, cheaper to construct and avoids the loss of light introduced by the prism erecting system.

On the basis of use, binoculars are classified as field and opera glasses. The field glass is of sturdy construction, relatively heavy and, except in the cheapest grade, is of the prism type. The opera glass is of lighter construction, is frequently richly ornamented and is generally of the Galilean type. *See also* BINOCULAR VISION. I. C. G.

**BINOCULAR VISION**, the property, resulting from the dissimilarity of sight in the two eyes by which one can estimate the distance to objects. The image of an object formed on the retina of one eye differs slightly from that on the retina of the other because the eyes view the object from different positions. By long experience, human beings have come to associate this difference with solidity, thus obtaining a sense of perspective.

A pair of eyes does not necessarily allow binocular vision. It cannot exist in birds and fishes, because they cannot converge their two optical axes upon a near point. For binocular vision, two fields of view absolutely coördinated in some manner in the brain are necessary. Binocular vision is the most important, but not the sole method of obtaining a sense of perspective. *See also* BINOCULAR INSTRUMENTS.

P. I. W.

**BIBLIOGRAPHY.**—Houstoun, *Treatise on Light*.

**BINOMIAL**, any mathematical expression consisting of two terms connected by the sign of addition (+) or of subtraction (−). For example  $a + b$ ;  $5x - \sqrt{2}$ .

**BINOMIAL THEOREM**, a theorem, formulated in a general way by Sir Isaac Newton (1676), by means of which a BINOMIAL can be raised to any power without resorting to multiplication, or a root can be extracted by INFINITE SERIES. Thus

$$(a \pm b)^2 = a^2 \pm 2ab + b^2$$

$$(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3$$

$$(a \pm b)^n = a^n \pm na^{n-1}b + \frac{n}{1 \cdot 2} a^{n-2}b^2 \pm$$

$$\frac{n(n-1)}{1 \cdot 2 \cdot 3} a^{n-3}b^3 + \dots + (-1)^{n-2} \frac{n}{1 \cdot 2} a^2b^{n-2} + (-1)^{n-1} nab^{n-1} + (-1)^nb^n,$$

where  $n$  may be positive or negative, integral or fractional.

**BINTURONG**, the black "bear-cat" (*Arctitis binturong*) of the Malay Archipelago. It differs from the allied palm-civets in the tufted ears and long, fully prehensile tail, freely used in climbing. The animal measures about  $2\frac{1}{2}$  ft. long in body, has harsh fur, bristly whiskers, and a snubbed muzzle. It is arboreal, hunting at night for birds, eggs, and small quadrupeds, but it also eats vegetable matter. Naturally fierce, the binturong responds slightly to taming.

**BIOCHEMISTRY** (biological chemistry) or physiological chemistry, as it was commonly designated until the present century, is the branch of the chemical disciplines which deals with the chemical manifestations of life or of substances that have been a part of living matter. This accordingly involves both animals and plants. Biochemistry, in its broadest aspects, is one of the so-called borderline sciences (like physical chemistry and astrophysics) in that it encompasses not only the chemical composition of the tissues and fluids that comprise biological structures, but also is concerned with some of the dynamic problems relating to life processes—to the chemical functions of animal and plant organisms. The latter activities are also necessarily a part of the sciences of biology and physiology.

#### SCOPE

The domain of biochemistry may be illustrated by some of the topics conventionally considered therein. Thus it deals with compounds that are conspicuous in, and characteristic of, the make-up of cells, tissues and organs. Foremost among them are the so-called proximate principles or foodstuffs, proteins, carbohydrates and fats, that, in addition to water and a few inorganic ingredients, comprise a large part of protoplasm in its varied forms and of other components of biological structures. Biochemistry is concerned with the unique chemical make-up of the aggregates of cells and intercellular materials known as animal and plant tissues and their derivatives—with the chemical organization of epithelial, connective, muscular and nervous tissues; the chemical peculiarities of leaves, roots, and tubers; the varied composition of blood, lymph and plant saps. It considers, further, the chemical aspects of the processes whereby nutrients may be disintegrated into simpler "units" out of which in turn new tissues are reconstructed; the chemical changes, such as hydrolysis, oxidation and reduction, involved in the metabolism or exchange of matter in life processes; the catalysts, notably enzymes, that facilitate metabolism and the transformation of energy incident thereto. This in turn is concerned with disintegration and synthesis, and inevitably with the excretion of effete substances. The chemical features in the respiration of animals and plants and intermediate forms; the genesis, composition and rôle of hormones and vitamins; the nature and function of animal and plant pigments, find consideration in biochemistry. Anomalies of composition and reaction—departures from the usual or expected—are sometimes considered under the designation of pathological chemistry, al-

though obviously no marked line of cleavage can be drawn between the normal and the abnormal, or pathological.

The recognition of biochemistry as an independent discipline is comparatively recent. In earlier years part of its field, insofar as animal studies are concerned, was encompassed in what was designated as medical chemistry, a pragmatic classification and a misnomer from the standpoint of the present day subdivision of the sciences. The first independent laboratories for the study of biochemistry (or physiological chemistry) were organized in Germany. In the United States the first definitive laboratory for the instruction of students was established in 1874 in the Sheffield Scientific School at Yale University. The first distinctive publication devoted solely to the needs of research workers in biochemistry was the *Zeitschrift für physiologische Chemie* founded by Professor F. Hoppe-Sayler in Germany in 1877. To-day biochemistry is recognized as a branch of science entitled to independent development in most parts of the educational world.

L. B. M.

#### BIOCHEMICAL CONSTITUENTS

The more immediate field of biochemistry is the general study of the composition of living tissue and the chemical changes taking place therein in normal and abnormal processes. This necessitates, first, the separation, identification and investigation of the chemical and physiological properties of tissue constituents; second, the determination of the amounts of these various constituents under various conditions; third, the origin, functions and fate of these cell constituents in the numerous activities of living tissues—such as digestion, absorption and assimilation for the repair of old or the growth of new tissues or for the conversion into heat, mechanical or electrical energy; and lastly, the nature and excretion of the waste products.

All living cells consist of water, carbohydrates, lipins, proteins, enzymes, hormones, vitamins, extractives, and inorganic salts. Over 95% of the entire living world is made up of water, carbohydrates, lipins, and proteins, the remainder is composed of inorganic salts, extractives, enzymes and hormones. Numerous investigations show that there are many kinds of carbohydrates, lipins, and proteins in protoplasm, more or less specific for each cell and organism. Proteins especially are so definitely specific, that one usually attributes the recognized specific characteristics of a given cell, organ, or organism to the proteins therein; in other words, that the specific structure and machinery is made up mainly of the proteins, while the carbohydrates and lipins serve more generally for energy purposes and the intermediate chemical reactions.

**Proteins.** The proteins are composed of the elements nitrogen, carbon, hydrogen, oxygen, and sulphur, and frequently some other elements as well, such as iron, phosphorus, copper, iodine, etc. The proteins contain these elements in numerous units,

called amino-acids, combined in such a way that we usually have one molecule of water lost for every two amino-acids combined with each other. The number of different amino-acids found thus far in proteins is twenty and there probably are more. Some proteins, when analyzed, are found to contain all of the amino-acids and some only part of them, and in different amounts. This at once leads to innumerable proteins of different composition and structure and hence of different properties and with different biological reactions. We have immunological reactions: the antibody formation, the precipitin, agglutinin, and anaphylaxis reactions, all involved in these biological responses and usually also associated with a most remarkable specificity of the toxic agent. This toxic agent usually is a specific protein. By means of these reactions, also, one can determine accurately in a minute speck of flesh tissue or blood, from what species of animal or plant the material originated.

Although animals are able to synthesize some of these amino-acids in proteins, nevertheless the animal kingdom depends largely upon plants to prepare these amino-acids and supply them in the form of proteins. Biochemical studies have shown that certain of the amino-acids have very remarkable and specific functions. Three of them, histidine, lysine and cystine, are necessary for growth and another, tryptophane, is required for life. If, then, the protein intake of animals is too low or too limited in type, disturbances in nutrition may result.

The proteins taken in our foods are, however, not all resynthesized into new tissue proteins. The proteins absorbed in excess of the amount needed for repair and growth are at once either utilized for energy purposes or converted into and stored as carbohydrates and fats. In these chemical reactions leading to the energy changes, the nitrogen contained in the protein is wasted and excreted as urea, uric acid, etc. This means that some of the carbon and hydrogen of the protein is not utilized for energy purposes. Obviously, proteins are not economical sources for energy, whereas carbohydrates and lipins are. (*See also PROTEINS.*)

**Carbohydrates.** The carbohydrates are compounds containing carbon, hydrogen, and oxygen in such proportions that one can think of them as hydrates of carbon, that is, one can ascribe to them a general formula such as  $C_nH_{2n}O$  or  $C_nH_2(n-x)O_{(n-x)}$ . As celluloses they form the skeleton and supporting framework in plants. As starch and glycogen, they serve as very easily available stores of energy in plants and animals after passing through the intermediate stages, maltose and glucose. As the glucose is utilized by the living tissues, it is in part oxidized into carbon dioxide and water, and in part into lactic acid and to other reacting substances, such as are involved in the formation of fats and proteins from carbohydrates. When carbohydrates are absorbed in excess in the mammal, they are either stored as glycogen, or converted into fats and lipins in general. (*See also CARBOHYDRATES.*)

**Lipins.** Under the term lipins we include many fat-like substances; the most important of these are fats, oils, waxes, sterols and phospholipins. The *fats and oils* contain carbon, hydrogen and oxygen; they may be considered as organic salts of organic acids with the alcohol, glycerine; such compounds are called esters. The fats and oils are very widely distributed in living tissues. They are formed in both plants and animals, in part from carbohydrates and in animals probably also in part from proteins. These substances constitute the food of the highest energy content, containing 2.2 times as many potential calories per unit weight as carbohydrates or proteins. The fats also are very economical in the volume they occupy in protoplasm; they do not possess the power of holding water like carbohydrates and proteins. The final fate of the fats in normal animal activities is that they are oxidized to carbon dioxide and water. In disturbed carbohydrate metabolism, such as diabetes and in abnormal fat metabolism, this oxidation is not quite so complete and as a result a part of the partially oxidized acids appear in the urine. See ANIMAL FATS; ANIMAL OILS; OILS; VEGETABLE OILS.

The *waxes* are very similar to the fats and oils in their chemical nature, except that they contain more complex alcohols in place of the glycerine. They appear to be waste or excretory products which probably originate from carbohydrates, but are not of value as foods. Beeswax and spermaceti are the best known waxes.

The *sterols* are very complex alcohols very widely distributed in the animal and plant kingdoms. Nervous tissue is particularly rich in these substances. The sterols probably function in part in a physical manner in the ultramicroscopic structure of tissues; they are not used for energy purposes, but probably are in part converted into certain acids found in the bile; they also appear to be related to vitamin D and possibly to certain "sex hormones."

The *phospholipins* are closely related to the fats in that one or more of the fatty acids combined with the glycerine may be replaced by a phosphoric acid compound of a nitrogen-containing organic base. The phospholipins are also very widely distributed and probably function both physically and chemically. Physically they may function in keeping protoplasm in an emulsion state, probably aiding in the solution and transfer of fats and possibly also as intermediate compound-formers of certain cell constituents. They may act in part as carriers of reserve base in keeping certain tissues in a neutral condition.

**Enzymes.** The enzymes are substances which act most remarkably under the conditions of temperature, acidity or alkalinity prevailing in living tissues in hastening very specifically certain chemical changes. They are the true catalysts of the chemical reactions necessary for the normal life processes. Thus, in digestion, the enzymes of the digestive tract, pepsin, amylase, lipase, trypsin, saccharase, erepsin, etc., act on the complex carbohydrates, proteins and fats in the food and convert them into more easily diffusible

and absorbable and less toxic substances so that the organism can rebuild its own specific tissue constituents from these simpler units. In the fermentative and putrefactive changes produced by microorganisms, the enzymes in the organisms bring about the chemical changes leading to the specific end-products. In the conversion of carbohydrates, fats or proteins into energy and waste products, numerous specific enzymes are involved. The enzymes have not been obtained in sufficiently pure form to enable us to say anything really definite about their chemical nature. The biochemist identifies them by what they do as catalysts. (See also ENZYMES.)

**Hormones.** The hormones or internal secretions are substances elaborated and secreted by specific organs into the blood stream, presumably to act upon some distant organ, nerve center or some constituent of the blood or tissues as a result of which we have better coordination between different parts of the organism. These substances are elaborated by the pancreas, thyroids, parathyroids, suprarenals, ovaries, testicles, and pituitary. The isolation and chemical characteristics of these substances present one of the main problems of the biochemists. Their physiological actions are just as remarkable as those of the enzymes but greater progress has been made in purifying these substances. ADRENALIN, thyroxin and INSULIN have been obtained in pure form and the two former have been prepared synthetically. (See ENDOCRINE GLANDS and also separate glands.)

**Vitamins.** By a vitamin, we mean a substance which, when absent in the diet of an animal, causes a certain pathological condition, which is easily remedied by the addition of a very small amount of the missing vitamin to the same diet. The various diseases one can produce and cure as a result of such dietary procedures are called deficiency diseases. See VITAMIN DEFICIENCY DISEASES; VITAMINS.

F. C. K.

**BIOGENESIS**, a word signifying the origin of life from preexisting life, contrasting with the antithetic word, **ABIOTENESIS**, the spontaneous and independent origin of living things from non-living matter. Used in this way, biogenesis expresses the universally accepted doctrine of present-day science. B. F. K.

**BIOGENETIC LAW**, a law formulated by Haeckel to designate the long observed fact that higher animals in their development pass through stages wherein they resemble lower forms. Considered as a support for the Theory of Evolution, it has also been stated as the Recapitulation Theory,—ontogeny or the development of the individual is a recapitulation or epitome of phylogeny or the development of the race. As von Baer's law (1828) the fact is emphasized that the resemblance is between the embryos or earlier stages rather than a correspondence of an embryo with the adult stage of a lower form.

In developing this generalization direct comparison was made between developmental stages and lower forms; thus, the first, unicellular, stage of develop-

ment, zygote, was compared with the unicellular protozoan; the blastula stage, end result of cleavage, with such colonial forms as *Volvox*; the gastrula stage, end result of gastrulation with a hypothetical form, the *Gastraea*, quite like the coelenterate *Hydra*, and so on. The developmental stages of the life cycle are considered under EMBRYOLOGY and LIFE CYCLE. As such comparisons are rarely close, Haeckel assumed that the ancestral record (palingenesis) was blurred and vitiated through alterations due to new adaptations in life (caenogenesis).

Among the many striking illustrations of the law may be cited the occurrence of gill slits in the embryos of mammals, as in man, the cat and the rabbit, and the presence of a temporary kidney, mesonephros, in the embryo of mammals which is permanent in the fish.

The weighing of the facts and the evaluation of the biogenetic law as a concept of the theory of evolution have led to quite divergent opinions as to its validity.

B. F. K.

**BIOGRAPHY**, a literary composition relating the life of an individual. The idea of writing a biography for the purpose of telling all one can about the man's life and character is comparatively new. The old biographers, including PLUTARCH, had some other motive, such as to air the author's views on moral philosophy, politics or religion. The real biography began about the time of Henry VIII. One of the earliest was the *Life of Sir Thomas More* written by his son-in-law and William Roper. Cardinal Wolsey's life, by George Cavendish, is a brilliant portrait of an extraordinary personality. Among the greatest English biographies are James Boswell's *Life of Johnson*, J. G. Lockhart's *Life of Sir Walter Scott*, and Southey's *Life of Nelson*. Washington Irving's *Life of Oliver Goldsmith* is one of the early American biographies. In recent years a new type of biography has come into vogue, highly selective in its presentation of facts and giving frankly the author's interpretation of his subject. The leading exponents of this kind are Lytton Strachey in England, André Maurois in France, and Emil Ludwig in Germany. See also ENGLISH, AMERICAN, FRENCH LITERATURE; AUTOBIOGRAPHY.

**BIOLOGICS**, the broad designation of serums, viruses, toxins, and analogous products used for the diagnosis, prevention, or treatment of disease. Such products may be divided into six general classes, namely: aggressins, bacterins (bacterial suspensions), serums, vaccines, viruses, and diagnostic agents. Representative products of each of these classes are, respectively, blackleg and hemorrhagic septicemia aggressins, blackleg bacterin, tetanus antitoxin, rabies and smallpox vaccines, hog-cholera virus, and tuberculin. Biologics are generally used singly but sometimes they are applied simultaneously as in the case of anti-hog-cholera serum and hog-cholera virus. Each biologic when properly prepared and used causes a specific reaction, which is not necessarily visible, when introduced into the system. Considerable skill is

needed to interpret visible reactions, following the use of biologics. In the human being, vaccination against SMALLPOX and, in animals, immunization of swine against CHOLERA, are typical examples of the use of biologics. Their production, being highly technical, should be undertaken only by competently trained or experienced persons. The Federal Government licenses producers of biologics, who distribute their products in interstate commerce and exercises supervision over their establishments and the products made. See also ANTITOXIN; IMMUNITY. J. R. M.

**BIOLOGY**, the science or study of life. The scope of biology is all knowledge concerning living things, i.e., plants and animals, including man.

The primitive man stalking game or seeking to escape a wild beast is making use of such knowledge as he has regarding the behavior and habits of animals. The savage who collects some fruit or herbs to use as food and carefully shuns others, or one who teaches his young which are good and which are bad, is by so much using knowledge of a kind that we should to-day call biological.

The term biology was first used at the beginning of the 19th century by Treviranus, the German botanist, and was adopted by Lamarck. It did not come into general use in its present sense until near the end of the last century, when the spread of the doctrine of evolution served to bring together in search of common problems and principles the students of various aspects of botany, of zoology and human physiology. The unity of all life had become sufficiently recognized to make possible the unification of all life studies and knowledges.

As knowledge, biology includes all the more or less reliable answers we have to whatever questions may be asked about plants and animals. As a branch of science, biology is the pursuit of answers to such questions, and in this pursuit we have used largely the methods of physics and chemistry; but there have been developed methods peculiar to the subject and necessitated by the nature of the material with which it is concerned.

Many of the questions about the workings of living plants and animals are physical questions, at least in part: How does a root absorb material from the soil? How does sap ascend in a tree? How do sound vibrations make an impression on a brain? How is color perceived? How do the kidneys separate waste from the blood?

Many of the questions raised by the contemplation of life are more distinctly chemical: What is the composition of the human body, or of the grass in the field? How are the materials of the air and water changed into nutrients? What is the source of the body's heat? How do living things derive the energy by which they do their work? How do poisons act? What makes a soil suited for certain crops?

The definition of life presents special difficulties because it is apparently a process, a succession of events involving numerous things and numerous forces, rather than a simple substance or object or force. A

living being is not only constantly changing, as is a waterfall or a volcano, but it presents a pattern of change that is quite peculiar. There is not merely growth from a small beginning, but with the growth there is development, a maturing, a change in proportions and in the interrelation of parts. There is an aging and apparently an extinction and death for every living individual. Time seems to play in life a rôle somewhat different from its relation to non-living things or processes. A child of 12 is not the same as an enlarged infant. Maturing means more than growing, and aging means more than wearing out.

Nearly everything that is true of all living beings may also be asserted of non-living things. This is particularly the case with the traits most commonly associated with life such as movements, growth, irritability and structure related to the division of labor. We frequently distinguish the quick from the dead by the single test of motion; but in nature, as well as among our own creations, movement is present in non-living things. Again, growth is to be observed in crystals and icicles and stalactites as well as in corn and kittens. Division of functions among the several parts or organs is to be seen in our artificial machines. Irritability, or sensitiveness to relatively minute disturbances, appears in animals through aroused movements or other responses disproportionate to the stimulus; but the photographic film, various detonating explosives, the photoelectric cell, the gyroscope, and newly developed sound-sensitive devices manifest sensitivities and discriminations that in some cases go far beyond what we find in most living things.

Yet it remains true that, with respect to each of the selected qualities or processes, living beings do differ from the corresponding features of non-living things. The growth of a crystal or of a stalactite is in effect a heaping up on the surface of more material of the same kind; in the growth of a plant or animal there is a taking in of foreign material, its transformation through various complex chemical processes, its final conversion into specific substances identical with those of the organism, and the deposition of these numerous substances throughout the body in a characteristic distribution related to the structure and behavior of the living body. This fact of assimilation, which is fundamental physically, is characteristic also in a metaphorical or symbolical sense, for living things tend to capture and transform to their own uses all of the environment. The converse, however, is also true, for the environment is not a passive one, and to live means not alone to convert the world to the needs of life, but also to adapt life to the conditions existing, the constantly changing conditions.

With respect to both the sensitivities of living things and to the activities aroused by stimulation, plants and animals show one important peculiarity. The movements of wind or stream are not merely determined or compelled by external forces, but they are without relation to the needs or interests of the wind or stream. The things plants and animals do are not only due to

internal processes, but they are generally related to getting the necessities, or to escaping dangers or enemies. This appears then to be a second fundamental characteristic about life, its adaptiveness.

While the close adaptation of plants and animals to the details of their living conditions is truly amazing, the adaptiveness of a given organism is far from absolute, and it is sharply limited by the similar strivings of the other living things in the environment. This failure of life to fit perfectly into the surrounding world lies in the very nature of things, rather than in the casual defect of a given plant or animal. We can see this when we consider that every living being has its enemies in other living things and that nearly every species may be injurious to some one or more others. If the frog, for example, were a perfectly adapted organism, the individual would succeed always in capturing every fly or worm at which he lunged; and he would escape every bird or snake that tried to get him. Similarly, if the fly or worm were a perfectly adapted organism it would escape every frog that tried to get him; and the perfect snake would surely capture the perfect, invincible frog. The struggle for existence is made up largely through the imperfections of adaptations; and it deals largely with variables in water, sunlight, soil composition, temperature, that is, inanimate factors of the environment that are intimately related to the process of living.

There is one final characteristic of living things that differentiates them sharply from the non-living objects of nature and the artificial objects of man's contrivance, and that is the mode of origin from other living individuals of the same kind. It is not that every plant or animal reproduces itself; but every living plant or animal has originated from another. That is to say, living may go on, sometimes indefinitely, without reproduction, but it can make a beginning, so far as we know, only in the bodies of beings already living: All life from life.

This brief survey of the outstanding peculiarities of living things and of their distinctive traits and relations is sufficient to suggest the vast range of problems with which any moderately alert intelligence must be beset when it turns itself seriously to a contemplation of life. The earliest questions that a child begins to ask have to do with identifying, naming, classifying the endless procession of animals, the endless display of plants. What is that? What kind of bird is this? What's the name of that tree? It was one of Adam's first tasks, according to the account in Genesis, to attach a label to each "kind." There have been described and named some two million different species of animals, about half of them insects, and about the same number of plants; and hundreds are being described every month!

The earlier attempts to record the known plants and animals all broke down through limitations of language and identifications. We can see how to-day one would soon get into difficulties if he had only the common names of plants and animals to go by. For ordering applesauce or bread, the indications apple or



wheat may suffice; but for the purpose of knowing one kind from another, several hundred names are needed for apples or for wheat. The efforts of the Swedish scientist, Carl Linnæus (1707-1778), to build up a system of naming and sorting plants and animals resulted in the so-called binomial system, which is in general use to-day. Linnæus pointed out that our common names of plants and animals usually stand for larger or smaller groups of species, not for single species. Maple is not a kind of tree, it is a whole collection of kinds, sugar maple, red maple, silver maple, curly maple and others. Both parts of the name are necessary if we are to be sure that we mean the same thing. The elaboration and refinement of systems of families, orders, classes, and larger and smaller divisions, as well as of minute descriptions and discriminations, constitute the branch of biology known as taxonomy; and its services are of special importance to students of genetics, the study of heredity, and plant and animal breeding, and to explorers for new forms, whether their interests are practical and commercial, or purely theoretical and pleasurable.

Classification naturally begins with the recognition of external resemblances. The progressive pursuit of the subject quite as naturally leads to the discovery of subtle differences and the cruder descriptions give way to delicate comparisons of finer details. The description of whole organisms led to anatomy, literally, a cutting apart or dismemberment. The systematic study of anatomy was long held back by the tradition which assumed that whatever was worth knowing had been long ago found out; and it was obstructed by superstitions and fears and quaint theological notions that held the dead body to be too sacred for the intrusion of idle curiosity. It was against great obstacles that, about 1540, Andreas Vesalius, a Belgian student of medicine, opened up a new world by dissecting cadavers.

Anatomy led on to morphology, or study of form, which concerns itself with a more philosophical consideration of the comparative structure of organs and organisms. Where the anatomist is content to record in minutest detail all that can be seen in a human hand, for example, the morphologist will want to know how each detail, such as a finger, a nail, or a particular tendon, compares with the corresponding part to be found in a rabbit, a horse, a frog. He is dealing with architecture, so to say, where the anatomist is dealing with structural engineering.

The study of anatomy leads off to further questions, for with the development of the microscope it has been possible to see ever smaller details of structure. The cells and tissues of which the organs are built up form the subject matter of histology.

The living body is recognized to be a constantly changing system so that our inquiry may proceed backward in time to asking: What were these structures at 15 years, at 5 years, at 1 year, before birth? The development of the individual plant or animal, from the moment of conception to maturity, furnishes the problems of embryology and development or ontogeny.

So striking is the fact that the various parts of an organism somehow serve the life of the totality in rather distinct ways that even young children will ask: What is the apple for? What is the navel for? Without attempting to answer such questions in precisely this form, physiology does try to find first, just what each part does, and secondly, just how each part works. The heart pumps the blood; but the circulation was definitely demonstrated by William Harvey, who died only in 1657. The stomach digests food and the kidneys eliminate waste from the blood. But just how is food digested, just how does the stomach carry on its work, just how do the various glands produce their peculiar juices, just how does each of these juices produce its particular effect, just how does a leaf manufacture sugar? The questions of the physiologist are also without number; and as in the case of the anatomical studies, physiological research extends ever into subtler and more delicate problems and discriminations. They reach also into the other fields, as in following such a question, for example, as, What happens in the fertilized egg-cell to bring about the next stage in the development? And then what brings about the next change, and the next? Physiology and anatomy constitute the foundations of the medical sciences.

The changes and activities of plants and animals are related to the external world, for life sustains itself through food which is often obtained from other living things. These include all varieties of attack and defense, adjustment to physical conditions, such as moisture, light, temperature, chemical factors in soil or water, changes in season, and whatever else may affect survival or extermination at one or another stage in the life cycle. Allied to this is the study of geographical distributions, which ties up also with the study of paleontology, or the problems of plant and animal distribution in time. What living things occupied the earth before our time, before our geological era? Through a study of fossils William Smith, an English engineer and surveyor, laid the foundations of this science; and his followers have been able to disclose most fascinating and impressive facts regarding life upon the earth in past ages.

Paleontology has been of great assistance to those who have tried to answer questions regarding the predecessors of existing species, for it has long been evident that the earth's population has changed through the ages. Thousands of species that existed at one time are no longer living. Moreover, there were times when the present species did not exist. Here are problems then that involve questions of ancestry and descent as well as questions of predecessors and successors. Whence came the backboneed animals? Whence came the carnivores, whence the primates? How did flowering plants originate? What is the source of the rose family? Questions like these concern students of phylogeny, and are commonly included among the chief problems of evolution.

The formulation of Darwin's theory of evolution by natural selection for the first time made possible

an extensive organization of research into the numerous problems that had occupied naturalists for generations: Darwinism supplied a framework for building up masses of observations, and later for systematic experimentation into the nature of living processes. Lamarck's theory of evolution as the result of the gradual accumulation, through heredity, of the effects of use and disuse made a wide appeal as being plausible, but did not lend itself so well to guiding scientific research. Darwin's theory did of course leave much to be desired, and there are still gaps in it notwithstanding years of intensive investigation by a growing army of investigators. Among the questions left open was that as to the origin of variations; and deVries attempted to answer this with his theory of mutations, based on observations, according to which "sports" or freaks appear from time to time with characteristics that distinguish them from their ancestors and that are transmitted to their progeny. Another important gap was a demonstrable theory of heredity. This has been gradually built up from the work of August Weismann, Gregor Mendel, Thomas H. Morgan and many other scientists.

So intricately related are the various processes that go on in a living plant or animal, that the specialized student finds great difficulty in keeping to his specialty; he needs constantly to suspend his work while he goes out to find what others have found in various fields. Problems of development involve information from physiology, ecology, and genetics. The geneticist calls constantly on the chemist and physicist, on the taxonomist and the cytologist. The most active areas of research to-day are in genetics, in the physiology of the internal secretions or hormones, in the origin and reversibility of sex, in the causes of development and of senescence, in the sources and development of parasitism, and in the effect of x-rays and other agents upon the hereditary and developmental characteristics of organisms.

The tremendous advances that the medical sciences have made since the last quarter of the 19th century are due very largely to the development of biology and biological methods of research. Outstanding was the revolutionary doctrine of the bacterial cause of disease, established by the illustrious LOUIS PASTEUR, who was not a biologist but a chemist. This has had far-reaching and more or less familiar results not alone in medicine but also in agriculture and industry. Biology has made substantial contributions also to psychology and agriculture and plant and animal husbandry. The construction of the Panama Canal was made possible by a series of brilliant biological investigations into the method of transmission and therefore the practical control of malaria and yellow fever. The extermination of Texas fever of cattle was another example of similar procedure. The combatting of insects, the most serious obstacle to successful agriculture, is based on highly specialized biological research. In protecting our natural and domestic plants and animals against enemies and disease, in increasing the yields of cows, hens, sheep, cotton, wheat,

sugar beets, and other cultivated organisms, in redistributing plants and animals from their native habitats to the places where we should like to have them, as well as in prolonging the lives of men and women and saving the lives of infants, biology has yielded values that cannot be measured in commercial terms.

B. C. G.

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**BIOLUMINESCENCE**, light emitted by living organisms. While fireflies are the most frequently observed of light producing animals, they are but one of many different kinds that are bioluminescent. Delicate jelly-fishes, marine worms and certain microscopic marine forms give off light but it is in the deep-sea animals that these organs are most abundant. Some of the deep-sea fish have rows of light producing organs on each side of the body. Fresh-water animals lack these organs.

It is a common observation that the flesh of a dead fish may give off a faint light and this has been known since the time of Aristotle. But it is now known that the light from the flesh of a dead fish is caused by light-producing bacteria in it. Decaying damp wood may give off light which is due to growth in the wood of fungus-like plants.

The explanation of the production of light is a comparatively recent scientific achievement. Two organic substances have been discovered and both must be present. The first of these is termed *luciferine*, a protein-like substance; the second is *luciferase*. Luciferase acts upon the luciferine like an enzyme and the reaction set up is an oxidation process. The light thus produced is accompanied by scarcely any heat, which has led to the characterization of bioluminescence as "cold light."

W. M. S.

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**BIOMETRY**, the mathematics of biological populations and processes. The term frequently is used interchangeably with statistics. However, statistics deals with the study of variation in data from any source, whether it be observations on the position of a star in space or on the tosses of a coin, while the field of biometry is more restricted. Each one deals with abstractions. For instance, when one endeavors to study man he finds himself dealing with the individual characteristics such as height or pigmentation rather than individual men. The mathematics of biological populations, just as the mathematics of other variable phenomena, is statistics. However, the present use of some phases of statistics is confined chiefly to the biological field. The control of experimental conditions, when living organisms are involved, is so difficult that frequently consecutive observations of the same phenomenon differ widely from each other. On this account biological data is apt to be highly variable. Also, in many cases, the number of obser-

uations that can be made is limited. Hence the statistics of small numbers assumes an important place in biometry.

Consecutive observations of any phenomenon produce a frequency distribution of such observations. There are three important types of such distributions, namely, Poisson's series, Bernoulli's binomial distribution and Laplace's normal distribution. However, averages of samples from populations conforming to any of these approach Laplace's normal distribution. Hence this one is of peculiar importance. The usual measure of variability is the standard deviation. In the normal distribution curve this is the distance from the mid-point to the point of inflection, or the point where the surface contour of the curve changes from concave to convex. The standard deviation of a distribution of averages is equal to that of a distribution of individual observations divided by the square root of the number of observations. Usually this quotient must be as small as possible in order that significance may attach to the results. Either of two procedures may accomplish this end. First, the divisor may be made large by increasing observations or by combining samples. Second, the dividend may be made small by analyzing the standard deviation into parts contributed by various sources of variability and retaining only those parts that are relevant to the problem under consideration. Processes for accomplishing this purpose are considered by R. A. Fisher under the head of *Analysis of Variance*.

When observations are few, the characteristics of the population can be estimated only approximately from the characteristics of the sample. As a result, the frequency distribution that expresses the most likely variability for the true population shows a close approach to the normal distribution only when the number of observations is large. The difference in shape of these distributions must be considered when dealing with small samples.

W. B. K.

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**BION** (c. 2nd century B.C.), Greek idyllic poet, was born at an unknown date, probably near Smyrna, and lived chiefly in Sicily. He may have flourished about 275 B.C., a contemporary of THEOCRITUS, though his date is more commonly placed about 100 B.C. According to tradition he died of poison in Sicily. Of Bion's works there now exist only fragments and the splendid threnody upon Adonis. The latter is a beautiful and moving lament for the slain god, and was possibly composed for certain religious rites. The poem has had many echoes in English literature, in Milton's *Lycidas*, Shelley's *Adonais* and in Matthew Arnold's *Thyrsis*. It was excellently translated into English by Elizabeth Barrett Browning. As a bucolic poet Bion lacked the spontaneity and naturalness of Theocritus. His verses are chiefly philosophic love songs. See also *BUCOLIC VERSE*; *GREEK LITERATURE*.

**BIOTITE**, a black, translucent mica commonly occurring in IGNEOUS ROCKS, especially the granites

and syenites, and a frequent constituent of schists and gneisses. It is often a product of igneous metamorphism. Biotite is a hydrous silicate of potassium, magnesium, iron and aluminum. The crystals look like short, hexagonal prisms but are really monoclinic. Because of its perfect basal cleavage it is usually found in flexible flakes. Biotite weathers to CHLORITE. See also MUSCOVITE; CLEAVAGE; PETROLOGY; SCHIST; GNEISS; GRANITE; SYENITE.

**BIPHENYL.** See *DIPHENYL*.

**BIQUADRATIC EQUATION**, an equation of the fourth degree. The general biquadratic may be represented by  $ax^4 + bx^3 + cx^2 + dx + e = 0$ . It was first solved by Ludovico Ferrari (1522-c.1560), a servant and pupil of CARDAN, the solution being published by the latter in his *Ars magna* (1545). See *EQUATIONS*.

**BIRCH**, an important group of woody plants containing many valuable timber and ornamental trees. Botanically they comprise the chief genus (*Betula*) of the birch family which includes also the alders, hornbeams and hazels. There are about 35 species of birch, widely distributed in the colder parts of the northern hemisphere, ranging from somewhat north of the arctic circle to Texas in the New World and to southern Europe, the Himalayas and Japan in the Old World.

The birches are mostly medium-sized trees of graceful habit, with conspicuously colored bark, ranging from white, yellow, and orange to reddish-brown and black, slender often drooping branches, and handsome bright-green foliage turning clear yellow or orange-yellow before falling in autumn. Usually the small flowers, the male and female in separate clusters (aments), bloom in early spring before the leaves appear. The seeds, contained within small winged nutlets readily dispersed by the wind, are borne in a dry conelike structure (strobile).

Birches extend to the northernmost limit of trees; the Alaska white birch (*B. alaskana*) is abundant in lat. 66° in the valley of the Yukon and the Old World white birch (*B. pubescens*) is a small forest tree in Sweden in lat. 70°, about 300 miles north of the arctic circle. Several birches are bushy shrubs and a few dwarf alpine and arctic species are almost herbaceous.

The fine-grained tough wood of various birches is utilized for fuel, charcoal, woodenware, furniture and numerous other purposes; the bark is used for making canoes, boxes and baskets and for tanning. Several highly decorative species, including many cut-leaved and weeping varieties developed by gardeners, are extensively planted in parks and lawns.

According to C. S. Sargent, there are in North America 12 native species of birch; of these nine attain the size of trees. They are most numerous and of greatest economic importance in the northeastern United States and adjacent Canada. In this region they form, with beech and maple, a predominant element in the transition forests intermediate between the oaks and the conifers.

Of the American birches the most valuable are the

canoe or paper birch (*B. papyrifera*), the yellow birch (*B. lutea*), the sweet, cherry or black birch (*B. lenta*) and the red or river birch (*B. nigra*). The canoe birch, very similar to the Old World white birch, is one of the most beautiful North American trees. In its typical form the canoe birch is found from Labrador to Manitoba and southward to New York, Iowa and Wyoming. It grows 60 to 70 ft. high with lustrous creamy-white bark, readily separating into papery layers. With this durable bark, which is impervious to water, the northern Indians make the coverings of their light, but extremely serviceable canoes. The soft, fine-grained wood is utilized for spools, shoe lasts and shoe pegs and also for fuel and pulpwood. There are several varieties of the canoe birch, some of which extend northward to the arctic zone and others westward to the Pacific coast. One of these, the western canoe birch (*B. papyrifera* var. *occidentalis*), found chiefly in Washington and British Columbia, is the tallest American birch, sometimes growing 120 ft. high.

The yellow birch, one of the largest deciduous-leaved trees of the northeastern States, occurs from Newfoundland to Iowa and southward to Georgia. It grows sometimes 100 ft. high and 3 ft. in diameter, with silvery or dark yellow bark splitting into thin curly layers. Yellow birch timber, one of the most valuable North American hard woods, is extensively used for furniture, interior finish and fuel.

The sweet birch, 70 to 80 ft. high, with strongly aromatic bark and foliage, is native from Maine to Ohio and southward to Georgia. From the bark and wood is extracted the oil of sweet birch, identical in its properties with the oil of wintergreen. The heavy reddish-brown wood is highly valued for furniture. The red birch, a semi-aquatic species, 80 to 90 ft. high, yielding valuable timber, is found from New Hampshire to Iowa, Florida and Texas.

In 1930 the total cut of birch lumber in the United States amounted to 284,465,000 bd. ft., valued at the mill at \$10,351,681.35. About three-fourths of this total was yellow birch, produced chiefly in Michigan and Wisconsin. For the year mentioned yellow birch ranked fourth highest in selling price among American woods extensively cut for lumber, being surpassed only by black walnut, ash and sugar pine. A. B. J.

**BIRD, ARTHUR** (1856-1923), American composer, was born July 23, 1856, at Cambridge, Mass. He spent most of his adult life in Germany, where he studied the piano, theory, orchestration, and composition with Haupt, Rohde, and Heinrich Urban. Bird became a friend of Franz Liszt, and under that master's auspices the American composer had his *Carnival Scene* played by full orchestra. Critics in Germany, where Bird was better known than in the United States, found his musical ideas fresh, and wrote highly of his lyrical gift. Among his numerous works are *Symphony in A*, *Serenade for Wind Instruments*, which won the Paderewski Prize in 1901, *Oriental Sketches*, for the organ, and the comic-opera *Daphne*. He died at Berlin, Dec. 22, 1923.

**BIRD, REMSEN du BOIS** (1888- ), American educator, was born in New York City, Jan. 3, 1888. He graduated in 1912 from Princeton Theological Seminary where, after studying a year in Berlin, he became an instructor. From 1915-21 Bird served as professor of church history at the San Francisco Theological Seminary and in 1921 became president of Occidental College in Los Angeles.

**BIRD LICE**, the name of several families of small wingless insects of the order *Mallophaga*, which are parasitic on birds and certain mammals. Their mouthparts are adapted for biting and chewing and dogs, cats, sheep, horses and cattle are subject to attack by certain species, although birds and domestic poultry are the greatest sufferers. For dogs, cats and poultry, use sodium fluoride in powder form. As a means of control coal tar or arsenical dips should be used for larger animals. See **POULTRY-LICE**.

**BIRDS**, creatures distinguished from the other major groups of animals by their covering of feathers. They form one of the principal groups of vertebrates, and are considered most nearly related to reptiles, standing in stage of development between that group and the mammals. They include about 25,000 different forms, of which between 700 and 800 are no longer living, being known only from fossilized bones and other remains.

Birds are widely distributed throughout the world, being common in most land areas and having their regions of greatest abundance in those parts of the continents lying within the tropics. Certain species of birds inhabit the open seas, except during their season of nesting when they resort to the land; and in fact there is no section of the earth's surface, except probably the ice-covered interior of the great Antarctic Continent, where some form of bird does not occur at least casually during some part of the year.

As a group birds are ancient and have had a long period of evolution. The oldest remains of fossil birds now known have been found in slate quarries near Solenhofen, Bavaria, in deposits of the Upper Jurassic period, which according to usual understanding have an approximate age of 125,000,000 years. Two nearly complete skeletons have been discovered in these deposits, one obtained in 1861 lacking the head, and the second secured in 1877 being more nearly complete. The first of these, now preserved in the British Museum in London, is known as *Archaeopteryx lithographica*, while the second in the Museum für Naturkunde in Berlin is called *Archaeornis siemensi*. These two creatures in their appearance offer so many reptilian characters that if it were not that their bones are accompanied by the definite impressions of feathers they would undoubtedly have been described as reptiles. These first known birds were a little larger than the ordinary domestic pigeon, with a more slender body, and a large number of tail vertebrae that formed a tail nearly as long as the head and body combined, from which feathers projected from either side throughout its length. The head in the complete specimen was short and there was no

bill, the jaws being armed with sharply pointed teeth. The bones at the tip of the wing that correspond to the human hand were separate instead of being fused as in modern birds, and were armed with claws. From the presence of feathers it is assumed that these reptile-like birds of the Jurassic period had warm blood, and from their form it is probable that they possessed the power of flight, though in this they may have been confined principally to scaling or sailing, perhaps without being able to progress for any great distance by flapping their wings. These are the most primitive bird-like creatures known. It is supposed that they were descended from reptilian ancestors allied to the *Pseudosuchians* of the Permian period.

In the Cretaceous period, with an estimated antiquity of seventy-five million years, there have been found remains of two types of birds with teeth which, aside from this character, are quite similar to modern forms. One of these, exemplified by *Hesperornis*, with teeth set in grooves, was an aquatic diver that had entirely lost the power of flight. The second form, *Ichthyornis*, with teeth in separate sockets, had strong powers of flight and was more or less gull-like in form. Beginning with the Eocene, at the opening of the Tertiary, sixty million years ago, toothed birds disappeared, and though a number of strange fossil forms have been found, all resemble in general characters one or another of the existing avian families. Toward the close of the Tertiary, in Miocene deposits, there are found fossil birds very closely allied to those of today, and in the Pleistocene or Ice Age there are known remains of many species that still exist. The study of fossil birds is as yet in its infancy, and annually additional species become known. In 1886 only 46 fossil species had been described from North America, while at the close of 1931 there were 156 fossil species known, and remains of 137 existing forms had been found in a fossil condition.

Ability in flight is characteristic of birds as a group, and the adaptations and development necessary for capability in flying have governed the general type of the avian body and its parts, and while permitting many curious and interesting variations have held birds as a group within clearly defined limits of form. It is true that there are birds such as the ostriches and penguins that do not fly, but their internal structure is such that it is maintained that their ancestors were flying species and that these forms have lost that power through specialization for running or swimming. As important developments to aid in flight it is found that the outline of the head and body in the attitude of flying is tapering and cylindrical, forming a stream-lined contour that offers a minimum of wind resistance. The tip of the wing has the bones fused together to provide a stiffened support for the wing feathers forming the planes that in their movement make flight possible. The wings, while light and strong, at the same time are flexible, so that they are adjusted quickly to changing air pressures and air currents encountered in flying, and when at rest may be folded compactly against the sides.

As an important modification for flight the great breast muscles that drive the wings are placed on the lower surface of the body where they give a low center of gravity affording stability in flight. These breast muscles are attached to the high keel of the breast bone which is specially developed for the purpose, and transmit their power to the wings by means of tendons, the muscles found on the wings themselves being small and of little bulk, with their function principally that of maintaining rigidity in the extended wing, of modifying its angles as the needs of flight dictate, or of holding the wing properly in place when it is folded against the body. The body skeleton is strengthened by bony plates known as the uncinata processes that extend across the ribs, and by the elongation of the shoulder blades over the sides of the back.

The flight feathers of the wing provide a light, strong supporting surface for flying, and in their support of the bird in the air are assisted by the long, strong feathers that form the tail. Through these important adaptations birds have become the most efficient flying creatures that exist.

With their covering of feathers indicated as the most important character distinguishing birds from other animals it is of value to describe the form and growth that feathers may assume. The body of a bird beneath its feather covering is angular and ugly compared to its appearance in its ordinary dress. The feathers externally appear smooth and even but on careful examination it is found that they are not continuous in growth over the body but arranged in definite areas called feather tracts with extensive spaces between known as apteria. This arrangement of feathers in tracts is according to a definite pattern that varies somewhat among the different groups of birds, but is uniform among individuals of the same kind.

Each feather grows as a shaft that is usually hollow at the base, forming the quill, which is embedded in the skin at the tip. The solid outer portion of the shaft ordinarily is slightly curved. At the attached end of the quill there is a tiny opening that gives entrance to the materials of which the feather was formed during growth, but that in the completed structure has no significance. On the lower side of the shaft in many birds there is an aftershaft springing from the upper end of the quill that is a small duplicate of the main feather in appearance. In cassowaries and emus the aftershaft is as large as the main feather, while it is entirely absent in ostriches, pigeons, cuckoos and various other birds. The main part of the feather, known as the web, is composed of barbs that grow out from the shaft like little branches, parallel and very close together. From the stem of the barb there grow secondary filaments known as barbules, while on the sides of some of the barbules there are further filaments called barbicels that terminate in little hooks designated as hamuli that attach to the adjacent structures. The barbs are easily visible to the eye but the other structures are tiny and may be viewed only under the microscope. The entire struc-



ture forms the soft, resilient web of the feather. In one of the wing feathers of a crane Gadow found 650 barbs composing the inner web. Each barb bore about 600 pairs of barbules making more than 1,000,000 for the entire feather. R. C. McGregor has found by count that there were 1,899 feathers on the body of a savannah sparrow, and 6,544 on a glaucous gull.

The ordinary feathers that cover the body of a bird are known as contour feathers, the large feathers that compose the wing and tail being of similar type. All have strong shafts and well-formed webs. Down feathers, with a strong quill but a weak shaft and a soft, non-coherent web are found concealed at the bases of the contour feathers, being especially abundant in ducks and in birds of prey. Filoplumes, long, hairlike filaments without definite webs, are found scattered over the surface of the bird's body among the contour feathers, and constitute the abundant "hairs" seen on the skin of a plucked chicken. A peculiar form of feather called powder down, found in a number of groups of birds, has a quill that is open at the upper end with a growth of feathery filaments projecting from it. The cellular sheath composing these barbs breaks up continually to form a fine gray or white powder that permeates the adjacent feathers, and that seems to be used as a dressing to maintain the plumage in good condition. Powder downs may be scattered singly over the body as in some parrots, or may be grouped in patches, as on the sides of the breast and rump in herons. They are found in only a small part of the species of existing birds.

Each feather on a bird's body grows from a little point that is contained within a tube-like pit known as the feather follicle. In the development of the feather from this follicle there comes a pin feather that as it grows bursts its enclosing sheath. When fully developed, the feather ceases growth and becomes then a dead structure. As feathers are delicate, and as time passes become worn and abraded, it is necessary to renew them at least once each year through a molt in which the old feather is cast off and a new one grows to take its place.

Birds vary widely in color and in pattern of coloration, many being plain and inconspicuous, and many possessing the most brilliant and varied hues found among living creatures, vying with flowers in their beauty, and surpassing the passive growths of plant life through their vivacity and sprightliness of movement. Coloration in the feathers of birds is caused in three ways. In many birds the structure of the feather is permeated by pigments that produce the shades of color characteristic of these forms. Such pigments come in two forms, the lipochromes or fatty pigments, as the red found in flamingoes, scarlet tanagers and the cardinal, and the melanins or black pigments that comprise the great group of dark pigments found in many feathers. In the melanins the size and abundance of the pigment granules have much to do with the color produced as this may cause a variation from black to gray according to the circumstances.

Structural colors are caused by mechanical arrangements in the feather, and are of two types, metallic and nonmetallic. In the metallic form where there is a polished or metallic appearance, there is an abundance of some dark pigment in the barbules, this color being overlaid by transparent sheath. In some birds the reflection of light comes from the smooth, even surface of the sheath, while in others it is caused by minute lines, either on the surface or beneath it. In the latter the color varies with the angle of light reflected from it, and may be modified by changing the position of the bird in relation to the angle formed by the source of light and the eye of the observer. This is found commonly in the plumage of humming birds where the feathers may appear dull or brilliant, or may scintillate brilliantly, according to the angle from which they are seen.

Nonmetallic structural colors are very common, the simplest being found in white feathers where no pigment is present, the white color being produced by refraction of light from the colorless barbules, a circumstance caused by their arrangement. Blue and green are among the common structural colors.

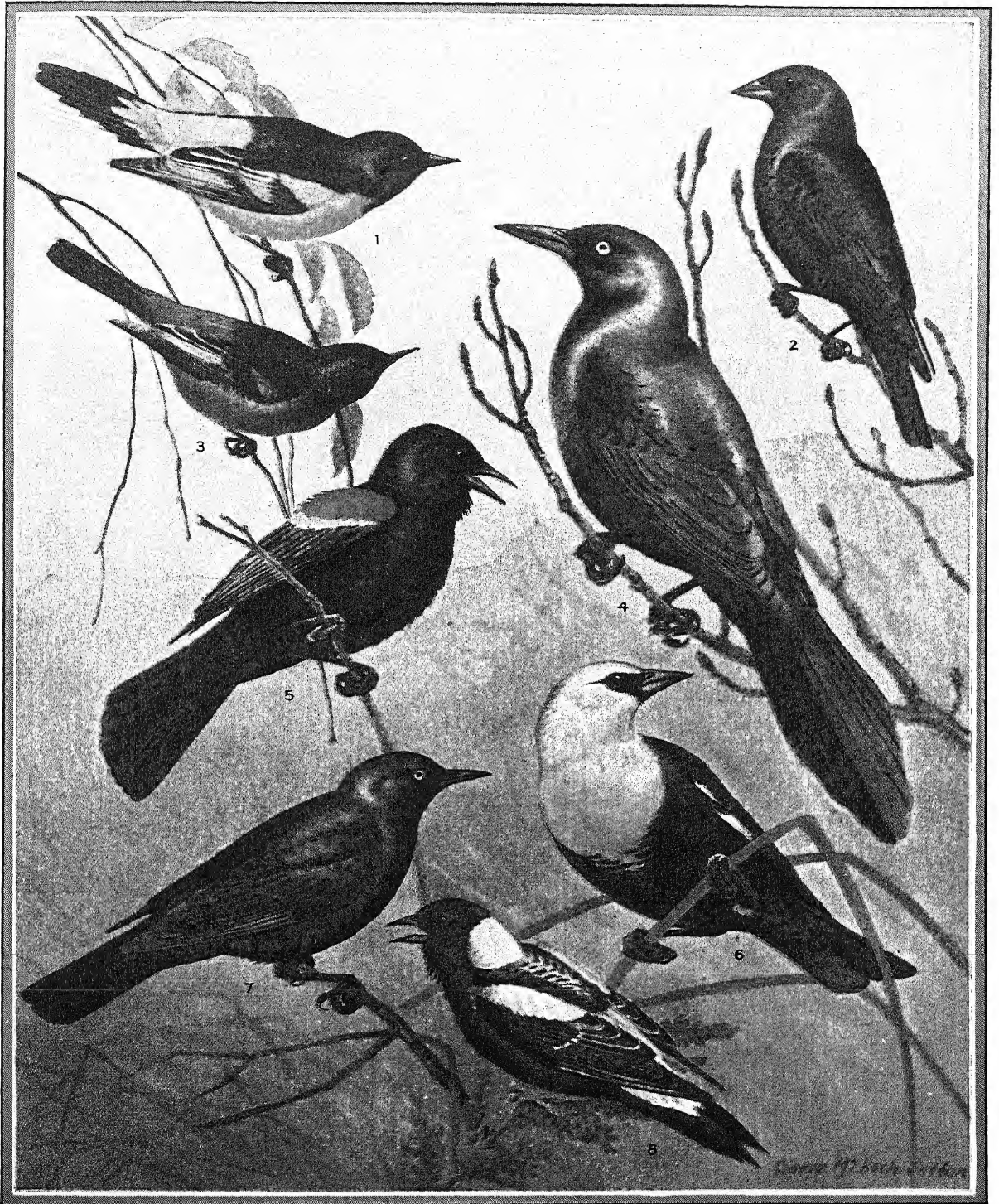
Among birds that normally have color in the plumage occasional individuals occur that are white or albinistic, this being due to an abnormal condition in which pigment is not formed. White blackbirds, white robins and other examples, while interesting in that they are unusual, have no particular significance except to denote abnormality from the usual condition. In melanism, the opposite of albinism, there is a superabundance of pigment so that a bird normally colored otherwise appears nearly or entirely black.

When the feather has been fully formed color changes only through wear, fading or by accidental staining, and cannot be otherwise modified in spite of the belief of many in so-called color change without molt. In the male of the widely distributed English, or house, sparrow, the throat in summer is deep black, and in fall and winter appears gray, slightly mixed with black. On examination of fall birds it is found that the tips of the barbs on the throat feathers are gray, while the concealed portions are black. At the advent of spring the gray tips wear away and disappear, leaving the clear black exposed.

The body skeleton of birds is light, and the limb bones are slender but strong. Large size in the breast bone is characteristic of most birds, this being small only in flightless species. The bones of the cranium fuse into a solid case that protects the brain, and there is reduction, partly through actual loss and partly through fusing, in the bones of the foot, and of that part of the fore limb corresponding to the human hand. The skull is supported on the vertebral column by a single articular condyle.

In the internal anatomy one of the most striking features in birds is the presence of five pairs of air sacs, connected with the lungs, that reach throughout the body, extending into the neck, and even penetrating some of the bones. Different species show considerable variation in the extent to which the

## BIRDS



PAINTED FOR THE NATIONAL ENCYCLOPEDIA BY GEORGE MIKSCH SUTTON

### AMERICAN ORIOLES AND BLACKBIRDS

1. Baltimore Oriole (*Icterus galbula*).
2. Cowbird (*Molothrus ater*).
3. Orchard Oriole (*Icterus spurius*).
4. Bronzed Grackle (*Quiscalus quiscula aeneus*).
5. Red-Winged Blackbird (*Agelaius phoeniceus*).
6. Yellow-Headed Blackbird (*Xanthocephalus xanthocephalus*).
7. Rusty Blackbird (*Euphagus cyanocephalus*).
8. Bobolink (*Dolichonyx oryzivorus*).



## BIRDS



PAINTED FOR THE NATIONAL ENCYCLOPEDIA BY GEORGE MIKSCHE SUTTON

### SPARROWS AND THEIR ALLIES

- |  |  |
|--|--|
| 1. Evening Grosbeak ( <i>Hesperiphonia vespertina</i> ). | 5. Indigo Bunting ( <i>Passerina cyanea</i> ).               |
| 2. Purple Finch ( <i>Carpodacus purpureus</i> ).         | 6. Rose-Breasted Grosbeak ( <i>Hedymeles ludovicianus</i> ). |
| 3. White-Winged Crossbill ( <i>Loxia leucoptera</i> ).   | 7. Cardinal ( <i>Richmondia cardinalis</i> ).                |
| 4. Goldfinch ( <i>Spinus tristis</i> ).                  | 8. Painted Bunting ( <i>Passerina ciris</i> ).               |





air cells enter the skeleton, and in the bones penetrated. For example, in pigeons the air sacs extend into the humerus, and in the swallows and ostriches they do not; while the hornbill and the pelican have most of the principal bones of the skeleton pneumatic. These air sacs form a reservoir for air and are supposed to function in heat control in the body.

The body temperature in all but a few birds is higher than in mammals, ranging from an average temperature of  $106.4^{\circ}\text{F.}$  in the domestic fowl to  $110.2^{\circ}\text{F.}$  in the white-throated sparrow. A temperature of  $112.7^{\circ}\text{F.}$  has been recorded in the western wood pewee.

Voice in birds is produced in the syrinx located at the lower end of the trachea or windpipe, at the point where this divides into the bronchial tubes leading to the lungs. The syrinx has cartilaginous walls derived from the windpipe or the bronchial tubes, while the tension of its delicate internal membranes that produce sound is regulated by special muscles. The form of the syrinx varies in different groups. The larynx, located at the upper end of the windpipe, which is the voice organ in mammals, in birds functions so far as known merely in slightly modifying sounds produced lower down in the syrinx. Vocal sounds made by birds vary from the harsh screams of macaws to the pleasantly modulated songs of robins and mocking birds, and are almost infinite in their variety. No bird so far as known is entirely silent, though voice in the adult brown pelican and turkey vulture seems restricted to a sibilant hiss produced by expelling air from the lungs.

The heart in birds is relatively large. The stomach is divided into a proventriculus, or glandular portion, that secretes the digestive juices, and a ventriculus that is more or less muscular according to the type of food. In seed eaters sand and gravel are swallowed to aid in grinding the food into particles suitable for digestion. The small intestine varies greatly in proportionate length in the different groups. Paired caeca or blind guts are present at the junction of the large and small intestine. These are small in perching birds and herons, being reduced to one in the latter, and large in owls and goatsuckers. The caeca are of maximum size in the crested tinamou of South America, where they have the appearance of two clusters of grapes. The large intestine is short and opens into a cloaca that receives the urino-genital ducts.

In the muscular system attention has already been called to the massing of the breast muscles on the under surface of the forward part of the body. A similar arrangement is found in the important muscles of the legs which are bulked on the thigh and the lower leg, near or against the body. The tarsus or exposed part of the leg is an elongated section of the foot with the toes at its lower end, its movement being controlled by tendons extending from the leg above. Neck muscles in the bird are strong, as the bill is used as a prehensor, in this function taking the place of the fore limb in various other higher vertebrates.

The nervous system in birds shows the principal advance that this group has made over the reptiles. The brain is relatively large, with extensive development of the cerebral hemispheres, which however lack the convolutions of the higher mammals. The olfactory lobes are small. Aside from the brain the strong nerves of the brachial plexus that control the wing, and of the sacral plexus that extend to the lower limb, are noteworthy. Sight is highly developed, the eyes being large. In most birds the eyes are located on the sides of the head, but in owls they are directed forward. As regards accommodation in sight birds seem to surpass all other vertebrates, the focus of vision seemingly changing rapidly and easily from near to far, so that a sparrow may in one instant see food lying only an inch or two away, and in the next may detect an enemy or some other object of interest a hundred yards or more distant. This power of accommodation is effected by the great development of elastic tissue in the various parts of the eye, affording flexibility of adjustment through which vision is varied at will. Necessity for this unusual development is found in the power of flight in which birds moving rapidly through the air have need to perceive instantly objects both near and far. Most birds have two points where vision is most acute, one being connected possibly with monocular vision, in which the two laterally placed eyes see separately, and the other with binocular vision where both eyes focus on the same object. Owls, with forward directed eyes, have one such foveal point, while the rapidly flying swifts, swallows and terns are reported to have three. In the eyes of all birds there is found a peculiar, pigmented fold of tissue known as the pecten that varies in size and form, and that is always present. The function of the pecten is in dispute though it is now believed that it is concerned mainly in the making of the vitreous humor. The statement that this organ is absent in the kiwi is erroneous.

Though birds have no projecting external ear the sense of hearing is acute. The ear opening, located behind and below the eye, is large, being especially developed in the owls.

The sense of smell seems slightly developed in birds, this being correlated with the small size of the olfactory lobes. The nostrils are located near the base of the upper part of the bill in most birds, being found at the tip only in the kiwi. The cormorants and allied species have the external nostril completely closed. Many have believed that carrion feeding vultures find food by a sense of smell, but this is in dispute, seeming more probable that this is accomplished by an acute sense of sight and an intelligence that leads these birds to note subsidiary factors, such as the activities of other animals, that point to food when actually the food substance may be completely hidden.

Through their highly organized nervous system birds are sensitive to touch through the feathers which have nerve endings at their bases. Snipe and woodcock have sensitized bill tips through which they detect food concealed in soft earth.

The sense of taste in birds seems poorly developed, the interior of the bill and the tip of the tongue usually being horny, with relatively few taste papillae. Most of the food of birds is bolted entire or in large morsels with no attempt at chewing, and many foods that are disagreeable to human senses are eaten without any indication of repugnance; as examples, the stink bugs or Pentatomids, that exude an evil-smelling fluid, are eaten by many birds, and the astringent berries of prickly ash, extremely disagreeable to human taste, are also taken. There is a certain sense of taste present, however, as crows reject corn that has been dipped in creosote, and birds that are not hungry will reject items of food that are eaten when hunger is acute.

The life of birds in general follows an annual cycle that corresponds to the seasonal changes of the year. Even in the tropics regular wet and dry seasons exert a rather definite control on the most of the bird life that comes within their influence.

Consideration of the life cycle may properly begin with the period of reproduction. At the approach of the nesting season in birds a conflict for territory begins between males in which each individual makes selection of the area in which later the nest will be constructed and defends it against encroachment of other males of its kind. This territory is extensive or restricted according to the needs of the species. The male mocking bird at this time preempts an area of shrubbery that covers a section of some extent, while with gregarious species that nest in colonies, as ibises and herons, several nests may be located in one tree or one clump of rushes. With territory under control the next effort of the male is to secure a mate. Among perching birds males at mating time resort to song. Woodpeckers select a resonant dead limb and beat a drum call on it with rapidly moving bills, grouse drum or hoot and various other birds utter or make sounds mainly peculiar to the mating period. With a female in attendance there follow a variety of posturings, dances and other peculiar attitudes that display prominent markings to full extent, as is seen in the strutting of the turkey gobbler and of the peacock. The white-breasted nuthatch spreads his wings fully and sways from side to side, the purple finch dances on a perch with crest feathers erected, and male grackles strut on the lawn with wings and tail spread and feathers ruffled. In the group of shore birds known as the phalaropes, the female is brighter colored than the male and is the aggressor in courtship, making the principal display and ardently pursuing the coyly retreating male.

The nests of birds vary in complexity from the slight hollows in the sands of beaches in which skimmers or albatrosses deposit their eggs, to the elaborately woven bags suspended from the tips of limbs that are made by various orioles. The nest of the spotted sandpiper is a slight hollow in the ground lined with a few bits of dried grass and weed stem, while that of the fish hawk, placed usually in some tree top may include a cartload of sticks. Woodpeckers cut nest cavities in dead trees or occasionally

in living tree trunks, which serve in succeeding years as homes for bluebirds, starlings, chickadees and other hole-nesting species. Shearwaters excavate nesting burrows in sandy flats, while belted kingfishers and bank swallows dig tunnels in the faces of cut banks to conceal their nests. These temporary homes may thus vary from the most simple structures to those that are highly complex. As previously stated the nest is placed somewhere in the territory that the male has selected except in a few species, as the prairie chickens, that pair at certain congregating points when the females meet the males but then steal away to hide their nests elsewhere.

Most birds are monogamous, taking but a single mate, though recent studies have shown that house wrens, for example, may mate with different individuals for different broods during the same season: The prairie chicken, turkey and various other species are polygamous.

Eggs exhibit great diversity in number, color and size. Shearwaters lay only one egg, the mourning dove deposits two, and most sandpipers and plovers three or four. The majority of the common perching birds as robins, catbirds and field sparrows have from three to five eggs in a set, and the bobwhite may lay from twelve to twenty-one. The number of eggs in a season is seemingly adjusted to the needs of each species for its maintenance, migratory birds in any group ordinarily having a larger number of eggs than species that are sedentary. As a rule, the kingbird and crow raise one family each year, the robin usually has two, the song sparrow often three, and house sparrows occasionally three or four.

Woodpeckers, pigeons and owls lay pure white eggs. The eggs of the ostrich are buff, while those of the cassowary are deep green. Tinamous of South and Central America have brown, green or pink eggs with a shell as lustrous as though made of fine porcelain. Many species of birds have the eggshell spotted with some shade of brown, this varying in intensity from pale shades to nearly black, changed to purple or lilac when the pigment becomes overlaid with some of the calcareous shell material, the combination of the white of the chalky shell and the brown color beneath producing this appearance.

The embryo within the egg is developed through heat applied during a period of incubation until it hatches. The rather uniform heat required is obtained in most cases from the body of the female parent who remains faithfully with the eggs, barely taking time to feed, until they hatch. In many species the duty of incubation is shared by both sexes; in humming birds it falls to the female alone, and in the ostrich it is assumed entirely by the male. The mound builders of the Pacific region and islands in the Indian Ocean cover their eggs in mounds of earth, where they are hatched by heat generated from decomposing vegetable matter, or from the accumulated heat of the sun.

The period of incubation varies widely. The egg of the cowbird hatches in 10½ days, but most of the eggs of the smaller birds require 12 to 16 days. The

mallard requires 28 days and the domestic fowl 21 days for incubation.

Ducks, grouse, ostriches and many other birds have young that are covered with down and are able to run about when hatched, being known as precocial. Hawks and owls, all perching birds, woodpeckers and others have altricial young that are helpless at birth, and remain in the nest for a period until they attain their growth. Practically all young birds remain under the care and guidance of their parents until nearly adult, and then in most cases wander away to their own devices.

Following the nesting season adult birds undergo a molt during which the plumage is renewed, most young following the same course, as ordinarily their first plumage is retained only a few weeks, and is then replaced by another covering. During this period birds are quiet and remain often in concealment. In most species the feathers of the wings are replaced a few at a time so that power of flight is not seriously impaired. As an exception to this ducks, geese, grebes, rails and flamingoes molt all the wing feathers at once, and for several weeks are unable to fly, remaining in situations where they are safe from ordinary enemies.

The annual migrations that many birds perform are one of the prominent phenomena in the lives of these species. Migrant species come into certain areas, usually in temperate regions, in the spring, remain through the summer, and then in the fall move to some other section, usually toward the Equator, to spend the period of winter. The chipping sparrows and robins that nest familiarly about homes in the northern United States fly south in the fall to a winter range in the southern states. Bobolinks travel to northern Argentina, and pectoral sandpipers and golden plovers that nest on Arctic tundras, fly south for the northern winter into southern South America. Many birds of the tropics have separate homes for breeding and for the resting period, and birds that nest in the higher altitudes of mountains often move to lower levels about the mountain bases after the nesting season. The activating principle that governs migration as it is found to-day is apparently physiological, being concerned with internal changes caused by the approach of the breeding season. With reproduction accomplished this impulse wanes. While this explanation may be accepted as the driving power that controls migration as it is now seen, the original causes that have brought about migration in the many species of birds in which it is a custom must be considered as complex, and not to be attributed to any single thing. Climate, temperature, food, light, overcrowding and other similar factors, must all have contributed to establish this habit. It is difficult to explain all of its complexities which, since birds as a group are ancient creatures, must have begun originally millions of years ago.

Food preference in birds is as varied as are the groups that compose the order. Herons and grebes consume fish, crabs and other aquatic animals; hawks and owls prey on mice and rabbits, a few kinds eating

other birds. Insects of all kinds are a favored food with a vast number of birds, and there are many species that feed extensively or entirely on seeds. Many take fruits and berries, and a few consume buds, leaves and herbage. Vultures feed on carrion, at times in an advanced state of decay.

Birds as a whole have definite economic value which has been recognized in the legal protection accorded all but a few species in many countries of the world. Insect-eating species are valuable for their aid in the control of insects injurious to crops, and game birds have great commercial value through the millions of dollars that are expended annually in preserves for their maintenance, and hunting. Other birds are interesting in an esthetic way to the thousands of persons who seek outdoor recreation. A. WE.

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**BIRD SANCTUARIES** now exist in many parts of the United States and to a lesser degree in Canada. A few have also been established in Great Britain and Europe. The forerunners of the bird sanctuary movement were the various Audubon societies, formed by bird lovers for the study of American birds. These and other study groups have promoted interest in the need for bird-life preservation and sanctuaries have been established as a result. In a true bird sanctuary, the birds are encouraged to make permanent homes to which they and their descendants return year after year. A typical sanctuary is a woodland plot combining, if possible, meadow and forest through which a stream flows or where there is a small pond. Here and there within its limits are placed bird houses of size and location suitable for different species. The chief requisite is that no hunting be allowed within the preserve and that cats and dogs be excluded. Materials suitable for nest building and grain, suet and other food are also often furnished. In many such sanctuaries the birds return year after year, and though absolutely wild when outside, are perfectly tame within the safety zone.

**BIRD'S-EYE MAPLE.** See MAPLE.

**BIRD SHOOTING** may be divided into shooting of land birds and of waterfowl. The 12-gauge double-barrel shotgun is most popular for land birds, and the heavier 10-gauge is used for ducks. In the United States land birds are usually hunted with setter and pointer dogs; but in Europe the birds are more often driven by beaters to the hunters waiting in blinds. Methods of hunting waterfowl are much the same everywhere, shooting being done from blinds hidden at the water's edge or from punts or duck boats. The use of decoys is more general in North America than in Europe. Spaniels and other retrievers are used on both continents.

The growing scarcity of game birds has aroused sportsmen to the necessity of tightening game laws and of increasing the birds. Especially in Europe, the

breeding of game birds is widely practiced. The establishment of game refuges and of large preserves is also assuring good bird shooting in the future. In Europe, the chief game birds are the grouse, partridge, quail, pheasant, snipe, woodcock and several varieties of duck. All these are found in North America, as well as the ruffed grouse, wild turkey, rice bird, prairie chicken and others.

Only practice can teach good shooting, for each bird offers different problems. The zigzag flight of the snipe differs greatly from the rocketing of a pheasant or the explosive rise of a ruffed grouse. The true sportsman observes game laws, tries to kill without crippling, and limits his bag. In the United States a good hunter does not shoot at a bird flying toward his companion, nor fire across another person's face. When birds are flying away from the hunters, shots are taken alternately. The man who shoots quickest is the best shot, and the first aim is usually most accurate. *See also* DUCK SHOOTING; PARTRIDGE SHOOTING; PHEASANT SHOOTING; QUAIL SHOOTING; WOODCOCK SHOOTING.

**BIRD'S-NEST FERN** (*Asplenium Nidus*), a handsome ornamental fern, native to Asia and Polynesia, and grown as a pot plant for its unusual and striking appearance. The stiff, undivided, bright green fronds, 2 to 4 ft. long, arranged in a circle around the crown, flare out from the stem near the surface of the ground, giving the effect of a nest in the center.

**BIRDS OF PARADISE**, a family of Oriental birds (*Paradisidæ*), noted for their gorgeous plumage. There are about 30 genera and over 70 species, scattered from Borneo to New Guinea and southern Australia. None is larger than the American crow, and most are smaller than our robin. A few live on or near the ground, but the majority of the species inhabit deep forests and hill-jungles, feeding mainly on fruits but also on insects, snails and tree-frogs; they do not sing but utter queer cries. They are active, shy, and hard to find or capture, except when a group of males in a leafless tree are indulging in their dancing-parties. The females of all species are inconspicuously dressed, and both sexes of some kinds are simply black; but in the typical forms, the males are arrayed in an amazing combination of colors and feather ornaments. The one best known is the great bird of paradise, mainly rich brown and yellow, with long dense tufts of golden, filamentous feathers, floating back from under each wing which were once articles of commerce, but as a decoration for women's hats are now forbidden in the United States and Great Britain.

E. I.

**BIRETTA**, a square cap with three peaked ridges on the upper surface commonly worn by Catholic clergymen of all grades. Its ultimate origin is a matter of conjecture, but it developed from a skull-cap with a tuft into a soft, round cap easily indented by the fingers in putting it on and off, giving the outline of the present three peaks. Even now the birettas vary in shape in different countries. That

their use was extended to all the clergy during part of the services is doubtless due to the unheated churches of earlier times. The color of the biretta corresponds to that of the cassock.

**BIRGE, EDWARD ASHABEL** (1851- ), American educator and zoologist, was born at Troy, N.Y., Sept. 7, 1851. He graduated from Williams College in 1873 and received his Ph.D. from Harvard in 1878. Between 1879 and 1925 Birge was successively professor of zoology, dean of arts and letters, and president of the University of Wisconsin; in the latter year he was made president emeritus. Birge has also been active in state departments. He was director of the Geological and Natural History Survey of Wisconsin from 1897-1919, a member of the State Forestry Commission from 1905-15, and a member of the Conservation Commission from 1908-15.

**BIRKENHEAD**, a municipal and county borough and seaport of Cheshire, England, situated on the River Mersey opposite Liverpool. A Benedictine priory was established at Birkenhead during the 12th century, but in 1801 the hamlet had only 110 inhabitants. Its subsequent growth began with the shipyards of William Laird, 1824, where the first iron vessels were constructed. The Confederate privateer *Alabama* that cost England £3,000,000 in indemnities to the United States was launched in 1862 from these yards. To-day the docks cover 506 acres, and are amalgamated with those of Liverpool, the amalgamation taking place in 1857 after a period of bitter rivalry. Besides sharing in the Merseyside port trade, Birkenhead exports Midland manufactures, and is the largest milling center in Europe. Vast abattoirs line the river front. The city in 1860 started the first European streetcar system, and boasts many fine public parks and buildings. Pop. 1921, 147,819; 1931, 147,946.

**BIRMINGHAM**, the second largest city in England, on hilly ground in a valley of the Tame. Nearby are rich coal and iron mines accessible by railroads and canals. It is the seat of an Anglican and a Roman Catholic bishop.

**Buildings.** The only medieval building is the Gothic St. Martin's Church of the 13th century in the old part of the city. The new sections have wide streets and imposing buildings, among them the Town Hall, built 1832-50, a copy of the Roman temple of Jupiter Stator, where musical festivals are held every third year; the Birmingham and Midland Institute of 1854, with large reading rooms; Central Library with a collection of musical instruments; Council House with collections of paintings and weapons, Market House, the Stock Exchange and numerous Anglican, Roman Catholic and sectarian churches.

**Educational Institutions.** Mason College was established 1875-1880 and became a University in 1900 with five colleges for theology, missions, pedagogy, technology and arts and crafts. There are many charitable institutions endowed by private individuals, among them the General Hospital, Queens Hospital, homes for the blind, deaf and dumb, indigent and orphans.

**Manufactures.** Birmingham is the center of the British metal industry, the value of the manufactured goods being more than £120,000,000 annually. All sorts of wares in gold, silver and alloys, finer and coarser kinds of steel and plated goods, needles, cutlery, nails, screws, pens, bronze and brassware, cast-iron and papier-mâché goods, umbrellas and trinkets are produced. It is also the center of the manufacture of firearms in England and has a mint for copper coins and automobile and motorcycle factories. Nearby in Handsworth are large factories making vases and candelabra, as well as iron and brass foundries.

**History.** Birmingham, mentioned in the Domesday Book, was partially burned in the Civil War of 1643. It owes its present importance to the perfection of the steam-engine and the utilization of the neighboring deposits of coal and iron. Pop. 1921, 922,167; 1931, 1,002,413.

**BIRMINGHAM**, a city of northern central Alabama, the largest city of the state and the county seat of Jefferson Co., situated about 98 mi. north of Montgomery. It is a port of entry in the Mobile customs district and is served by eight railroads and three additional local freight carriers, including the railway of the Warrior River Terminal Co., which is owned by the Federal government. This road runs to Birmingham, on the Warrior River, and affords a waterway to Mobile via the Alabama River system. With its excellent transportation facilities, Birmingham, the hub of the industrial development of its section, is justly termed the "Pittsburgh of the South." Its industrial leadership is based on extensive deposits of coal, iron, limestone, dolomite, cement-rock, graphite and marble close to the city. An ample supply of electric energy is also available. In 1929 the total value of its manufactures was about \$137,000,000, with steel, iron, machinery, cement and chemicals the most important products. The wholesalers distributed merchandise worth \$98,910,036, and the 2,820 retail stores, which did a total business of \$133,562,091, provided full-time employment for 14,274 men and women. Birmingham has a model courthouse costing \$3,000,000, a large airport, and an improved drainage system. The city is the shopping center for more than a million people. Birmingham has a fine public school and municipal recreation system. It is the seat of Howard College and Birmingham-Southern College, both coeducational institutions. The city was founded in 1871, and its growth has been substantial and rapid. It adopted a commission form of government in 1911. Pop. 1920, 178,806; 1930, 259,678.

**BIRMINGHAM**, a residential suburb 15 mi. northwest of Detroit, in Oakland Co., southeastern Michigan. It is served by the Grand Trunk Railroad. The Rouge Valley at Birmingham was the scene of a tribal battle between several thousand Indians in the early 19th century. Birmingham was originally settled in 1819; it was incorporated in 1864. Pop. 1920, 3,694; 1930, 9,539.

**BIRRELL, AUGUSTINE** (1850- ), English writer and statesman, was born near Liverpool, Jan.

19, 1850. He studied at Trinity Hall, Cambridge. By his *Obiter Dicta*, 1884, he made a name as a leading literary critic before becoming a Liberal Member of Parliament in 1889. In 1907-16 he was Irish Secretary. Among Birrell's works are *Life of Charlotte Brontë*, 1885, *Collected Essays*, *William Hazlitt*, 1922, and *More Obiter Dicta*, 1924.

**BIRTH, ACCIDENTS AND INJURIES TO NEWBORN DURING.** See CHILDREN, DISEASES OF.

**BIRTH CONTROL**, a term synonymous in the public mind with means for the prevention of conception. These include obviously continence and the use of various mechanical devices and chemical solutions, while recently attention has been given also to biologic methods and surgical measures.

Scientifically, birth control considers not only the prevention of conception and thereby the limitation of population, but also all the economic relationships of population to society. It thus concerns not only restriction of births in times of starvation and economic necessity, but also increase of the birth rate to provide an optimum population for good economic and social conditions.

Physicians are interested in birth control primarily from the point of view of health and the prevention of disease. Some women are unfitted by disease to bear children; in some instances children have come so rapidly as to break down the health of the mother, in other instances a disease of the father may make the bearing of children undesirable. Diseases of the heart and of the kidneys, diabetes, tuberculosis, epilepsy, feeble-mindedness and similar conditions have been considered a suitable basis for consideration as to the necessity of either sterilization or birth control.

From the ethical point of view, there are certain principles upon which most of those concerned with this problem are agreed. It seems certain that persons who are likely to transmit serious physical or mental taints to their progeny should not have children. Preventive measures which may injure the health of the parents or possibly unborn children should not be employed. Parents should not refuse parenthood for wholly selfish reasons. Except under medical advice, removal of the fetus after conception, or termination of pregnancy should never be attempted. In order to have intelligence applied to this problem in the future, sound instruction should be given to intelligent children as to the wrongfulness of sex immorality, the prevalence and dangers of venereal disease, the duties, responsibilities and privileges of parenthood, the importance of healthful children, and the value of family life to the nation and the race.

Opposed to contraception are the following arguments: (1) It is dangerous to disregard deeply-seated and widely spread institutions in which morality and religion are involved. (2) Marriage, the family and parenthood are necessary for the continuance of the race. (3) Continence is not incompatible with physical health; its dangers to mental health are debatable. (4) At certain times in the nation's history, particu-



larly following wars, decline in the birth rate threatens the nation's economic independence. (5) At present, birth control is quite certainly practiced by many of the more intelligent persons in society and not by the very elements which apparently require it most.

Unless the custom of early marriage and unlimited procreation are supported by a national religion and a national ethics, control over reproduction is undoubtedly practiced by part of the population.

Certainly, one motive for birth control is a desire to reduce the labor and responsibility of parenthood. Men begin to marry late, and those who do marry restrict the size of the family. The statistics show that this tendency of restriction begins early and works most strongly in those who have attained to some degree of leisure and culture. Those who remain subject to instinct and custom, continue to propagate more rapidly; while individuals who rise by exceptional capacity out of these elements promptly begin, themselves, to exercise control of reproduction.

To-day the chief difficulty with birth control is the fact that no method has yet been found which is scientifically, sociologically, psychologically and esthetically wholly satisfactory. Research is still being carried on in many institutions for a perfect biologic method. In the meantime, those using the unsatisfactory mechanical and chemical methods now available learn to practice psychologic adjustments which are serviceable to a certain extent.

The phrase "birth control" was popularized by Margaret Sanger who has written extensively on this subject, and who is the leading spirit in the American Birth Control League. M. F.

**BIRTH RITES**, among primitive peoples, a ceremony based on the belief that childbearing renders a woman unclean and consequently magically dangerous. During childbirth and possibly for some time afterward, the mother is kept in seclusion and later purified by a special ceremony. Her attendants may also be purified and any vessels she has used purified or destroyed. A ceremony is often made of disposing of the child's navel string, which is put in a safe place in the belief that its fate will influence that of the tribe.

**BIRTHROOT**, a name formerly often given to the ill-scented *TRILLUM* or wake-robin (*Trillium erectum*) with reddish-purple flowers and astringent rootstocks reputed to possess medicinal properties.

**BIRTHS AND BIRTH RATES.** The total number of births in Continental United States, during 1928, was approximately 2,500,000, or at a rate of 19.7 per 1,000 of population. In 1915 the rate was 25.1, so that there is evidence of a measurable and continuous decline during the intervening 13 years, a decline which may be expected to continue in view of the increasing practice of **BIRTH CONTROL**. The United States **DEATH RATE** in 1928 was 12.2 per 1,000, so that there is a natural increase in population of 7.3 per 1,000, or considerably less than normal for civilized countries which may be placed at 10 per 1,000. Compared with foreign countries the

rate is rapidly approaching the lowest level as shown by the following comparative figures for the year 1928: Belgium, 18.4; Sweden, 16.2; England and Wales, 16.7; Switzerland, 17.3; Norway, 18.0; France, 18.2; Germany, 18.6; Denmark, 19.6; New Zealand, 19.6; Scotland, 19.8.

The actual fertility of modern nations is therefore enormously below potential figures as indicated by certain countries, more or less primitive, in which the birth rate is still maintained at high levels. Of these may be mentioned British Guiana with a rate of 28.3 per 1,000; Ceylon, 40.0; Egypt, 43.3; Jamaica, 35.8; and Japan, 33.6 (1927). The birth rate of the Dominion of Canada in 1927 was 24.6 per 1,000 but it was as high as 31.9 for the Province of Quebec. In England and Wales the rate was as high as 34.5 per 1,000 during 1871-80, falling to 15.1 during 1929. For the city of Paris the rate was as high as 39 per 1,000 during 1827, falling to 30.1 by 1850, 25.6 by 1880, 17.5 by 1910, and 15.0 by 1928. In Sweden the birth rate has fallen from 33.5 in 1854 to 27.1 in 1894 and 15.15 in 1929.

The foregoing figures suggest the enormous potential fecundity possibilities of different nations if fully realized. Hence there is a tremendous population loss resulting from voluntary methods of birth restriction, and what is equally patent, a diminution of conceptual possibilities. The latter is generally obscured by discussion of the former which are more in evidence.

The natural population increase the world over is suffering checks at the present time quite disproportionate to the checks observed in former generations. Small families are becoming the rule while large families are the exception. Economic pressure unquestionably has some bearing upon the problem but it is notorious that the small families are chiefly met with among the well-to-do and highly educated, while large families are still fairly common, but decreasingly so, among the poorer elements of the population. The average number of children born to women in the United States in 1928 for all classes was 3.2. It was 3.2 also for the white population and 3.7 for the colored. It was 3.9 for mothers born in foreign countries, having been highest for mothers born in Poland or 4.9, followed by Italy with 4.5, and Austria-Hungary with 4.5 also. There is some evidence that the number of children of mixed parentage is rapidly increasing.

Plural births are of scientific importance, though numerically relatively rare. While there were 2,182,879 single births in the United States during 1928, there were 25,619 cases of twin births, 285 of triple births and one case of a quadruplet birth. Plural births, therefore, form 11.7 per 1,000 of all births.

Illegitimate births in the United States in 1928 formed 3.09% of all births, or respectively 1.67% for the white population and 13.7% for the colored population. An international comparison of illegitimate births is ill advised on account of the effects of legal restrictions on marriage and other factors. As for

example, in such a country as Trinidad, illegitimate births in the total population formed 60% of all births. In the East Indian population they formed 88.9% in 1929. In Jamaica, the proportion of illegitimate births in 1929 was 71.5%.

Race and religion unquestionably powerfully affect the birth rate. In Palestine, for illustration, in 1929 the birth rate of Christians was 37.8, of Moslems, 57.7, of Jews 34.1, and of other religions 43.7. For the whole country of Palestine the birth rate in 1929 was 51.15, showing an extraordinary fecundity unaffected by modern conditions. In Ceylon the birth rate for all races during 1929 was 36.5, but the rate was 16.6 for Europeans, 32.4 for Burghers and Eurasians, 39.4 for Sinhalese, 39.4 for Tamils, 38.4 for Moors, and 50.0 for Malays. F. L. H.

**BISBEE**, a city in southeastern Arizona, the county seat of Cochise Co., situated in an important mining region producing copper, gold, silver, zinc and lead. It is 7 mi. from the Mexican border on the Southern Pacific Railroad. The city is built in a canyon. An interesting sight in Bisbee is the "Pit," an excavation several hundred feet deep and 18 acres in area dug out of Sacramento Hill, a copper mountain. Ore mined in Bisbee is treated in DOUGLAS and other neighboring towns. Beautiful and notable features of the vicinity are the Wonderland of Rocks, Faraway Ranch and Coronado National Forest. Bisbee was founded in 1879 and incorporated in 1902. Pop. 1920, 9,205; 1930, 8,023.

**BISCAY, BAY OF**, an indentation of the Atlantic Ocean, lying on the southwestern coast of France and the northern coast of Spain. Some of the principal rivers of France enter the bay, among them being the Loire, Gironde, Adour and Charente. Situated near or on the bay are the ports of Nantes, Bordeaux, Lorient, and Bayonne. On the Spanish coast are the ports of San Sebastian, Bilbao and Santander. The depth of the bay varies from 20 to 200 fathoms. Owing to its exposed position, it is subject to severe storms and high currents.

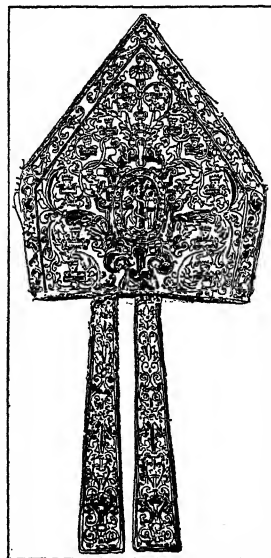
**BISCEGLIE**, a seaport city in Bari province, Apulia, Italy, situated on the Adriatic Sea, 15 mi. southeast of Barletta. The city contains a cathedral, consecrated in 1295, the 12th-century church of St. Margherita with tombs of the Falconi, and a ruined castle of the Hohenstaufen. Four miles to the south is a great neolithic dolmen. Bisceglie exports chiefly fruits and oil. Pop. 1931, 31,477.

**BISECTOR**, a straight line bisecting an angle, a segment of a line, or any geometric plane figure.

**BISHOP, SIR HENRY ROWLEY** (1786-1855), English composer, was born in London, Nov. 18, 1786. He studied with Bianchi in London. At the age of 23 his dramatic opera, *Circassian Bride*, was successfully produced at Covent Garden, London. In 1810 he became director of music at Covent Garden, and while in London composed his *Lady of the Lake*, *Guy Mannering* and other operas. *The Fortunate Isles* was produced in 1840 in honor of Queen Victoria's wedding. He wrote the melody for

*Home, Sweet Home*. He was one of the founders of the London Philharmonic Society and in 1848 became professor of music at Oxford University. He died at Oxford, Apr. 30, 1855.

**BISHOP** (Greek *episcopos*, overseer), the title of an ecclesiastical dignitary who has received the highest of the HOLY ORDERS and exercises administrative functions in a district called a diocese; therefore also called diocesan or residential bishop or bishop in ordinary. The title goes back to apostolic times (I Timothy 3:1; Titus 1:7; Philipians 1:1). In the course of the 2nd century, however, the chief elder, as *primus inter pares*, assumed responsible charge of all the affairs of the parish and was termed bishop in that specific sense, thus outranking the presbyters. He was considered a successor of the apostles and thus had special honors and privileges, such as ordination and confirmation. Originally all bishops were equal but, as the rural parishes were administered from the cities, the country bishops, *chorepiscopi*, came under the city bishops. The still greater prestige of the bishops of capitals brought about further distinctions of rank, which gave rise to the Hierarchy. The episcopal office embraces the preservation and propagation of the doctrine, thus also the education of the clergy, whereby, as in the case of his priestly functions, the bishop is in some countries assisted by the cathedral chapter. In early times the bishop's assistant was the archdeacon. At present he is aided by an official (ecclesiastical judge) or by a vicar general as deputy for the diocese, and by rural deans, *vicaroforane*, in the various districts. (See articles under these heads.) Originally the bishop was elected by the parish and later was, in many cases, appointed by sovereigns. According to the Council of Trent, he was to be elected by the cathedral chapter. At present the pope appoints bishops at his own discretion in most parts of the Roman Church, although in some dioceses the cathedral chapters or other bodies still have the right of nomination. Those states which have a CONCORDAT, an agreement between the papacy and the government, have the right of suggesting nominees for the vacant dioceses, and from these the pope may make his selection. In general, the position of the bishops and archbishops of the Greek Church is the same as in the Roman, but they are always selected from the monastic clergy, usually from ARCHIMANDRITES and PRIORS. Of all reformed churches, only the Anglican has retained the epis-



COURTESY M. M. OF ART

16TH CENTURY BISHOP'S MITER

copate in full with the special rights and privileges (*jura ordinis*) flowing from the episcopal consecration. In the Church of England the bishop, although nominally elected by the cathedral chapter, is appointed by the government, while in the American Episcopal Church he is elected by a diocesan convention composed of clerical and lay deputies. Sweden has retained its bishops and archbishops and granted them great influence, as has Denmark. There are bishops in many other denominations also, but their functions as such are administrative only.

An auxiliary bishop in the Catholic Church is an assistant to and deputy of a diocesan bishop. He is always a titular bishop.

A bishop-coadjutor, in the Catholic and Anglican churches, is the same as an auxiliary bishop, except that he has the right to succession upon the death or resignation of the ordinary. In the Catholic Church he is always a titular bishop. A diocesan bishop is a residential bishop or bishop-in-ordinary. A bishop-elect, in the Catholic Church, is one who has been appointed by the Holy See or whose canonical election has been confirmed by the Holy See, but who has not yet been consecrated. He has full jurisdiction in his diocese, but cannot exercise his special episcopal powers (*potestas ordinis*) until consecrated.

**BISHOP COLLEGE**, at Marshall, Tex., founded in 1881 as an institution of higher education for Negroes, is coeducational and privately controlled. It maintains preparatory, arts and sciences, and theological departments. In 1931 the productive funds were \$13,847. The library contains 6,848 volumes. In 1930-31 there were 346 students, and a faculty of 21, headed by Pres. Joseph J. Rhodes.

**BISHOPS, TITULAR.** After the 13th century, auxiliary bishops, vicars-apostolic and other prelates were granted by the popes the title of bishop *in partibus infidelium* (Latin, "in the regions of the unbelievers"), as mere titular bishops of sees long lost to the Catholic Church. In 1882 the late King George of Greece protested to Pope Leo XIII that the Greek Orthodox were offended at this use of the phrase in connection with ancient sees of Greece, and the Pope discontinued the usage, so that such sees and such bishops are now "titular."

**BISHOP'S-CAP**, a name often applied to the two-leaved Miterwort (*Mitella diphylla*), a delicate woodland wildflower of eastern North America.

**BISHOP'S SCHOOL**, an institution for the secondary education of girls at La Jolla, Cal. Through gifts of land and money from the Misses Ellen and Virginia Scripps, the school was established in 1919 by the first bishop of Los Angeles, and it has since been maintained by the Episcopal Church. The curriculum covers a seven-year course from the sixth grade through high school and college preparatory work, and is open to girls from 12 to 18 years. In 1931 there were more than 100 pupils enrolled, and a faculty of 22 members.

**BISHOPS' WARS.** Two conflicts between Charles I and the Scots are called the Bishops' Wars

because they were occasioned by the Scots' protest against the king's ecclesiastical policy. In Nov. 1638 the General Assembly of the Church of Scotland abolished episcopacy and re-established Presbyterianism. The next summer, Charles marched his raw levies to the border, but was obliged to yield to the Scots. In 1640 the Scots invaded England and refused to make any agreement unless it were ratified by Parliament. This terminated Charles's attempt at personal rule, caused the summoning of the Long Parliament, and hastened the advent of civil war.

**BISMARCK, OTTO EDUARD LEOPOLD VON BISMARCK-SCHÖNHAUSEN** (1815-98), was born Apr. 1, 1815 on the family estate at Schonhausen in Brandenburg, the third son of Ferdinand von Bismarck (1771-1845) and Wilhelmina Mencken (1790-1839). At the age of six Bismarck was sent to Plamann's Institute in Berlin, and in 1827 he entered the Friedrich-Wilhelms Gymnasium. From 1830 until the spring of 1832 he attended the Gray Cloisters, and then went to the University of Göttingen to study law. At the university he achieved prominence as a drinker and a fighter, and became a member of the famous duelling corps *Hannovera*. After three additional terms of study at Berlin, 1833-35, and the successful completion of his examinations, Bismarck became auscultator in the municipal court at Berlin. In 1836 he was advanced to the post of referendary at Aachen, and the following year he occupied a similar position at Potsdam, simultaneously fulfilling his military obligations in a chasseur regiment.

The fall of 1838 saw him transferred to Greifswald where, in addition to performing further military duties, he studied husbandry at the Eldena Academy. He became all the more interested in this study when, in 1839, it fell to his lot to administer the financially-unsuccessful family possessions in Pomerania. During the ensuing few years he read a great deal of German and foreign literature and history, and traveled in England and France. Upon the death of the father in 1845 the family property was divided, Otto receiving Schonhausen and Kniephof in Pomerania. In 1847 he married Johanna von Puttkamer (1824-94).

After dabbling in local politics for a time, Bismarck became notorious for his violently conservative stand in the Prussian constitutional struggles of 1848-50. He helped found some political clubs and newspapers, including the *Neue Preussische Zeitung*, later, the *Kreuzzeitung*, to combat the organizations and papers of the liberals. As a member of the Prussian lower house in 1849 and the Erfurt Parliament in 1850, he attracted the favorable attention of the king. In 1851 he was made successively legation secretary and envoy of Prussia to the Federal Diet at Frankfurt. Here he favored at first a policy of cooperation between Prussia and Austria in the interests of German unity, but he was ever on the alert to see that Prussia in no way appeared inferior to Austria in the counsels of the Confederation. Soon his observations of Austria's dilatory tactics convinced him that Prussia alone was qualified for the task of uniting Germany.

He was sent on several minor diplomatic missions during 1850, but his anti-Austrian attitude eventually led to his transfer from Frankfurt to the ambassadorial post at St. Petersburg in 1859. Here he cemented friendships which later were of great value in enabling him to bring about the diplomatic isolation of Austria and France. In the spring of 1862 he was appointed ambassador to Paris, but soon was recalled to Prussia to aid the king in a conflict with the Prussian lower house over budgetary appropriations for an improved army. On Sept. 24, he became *ad interim* head of the government, and on Oct. 8, he became minister president with the portfolio of foreign affairs.

Bismarck's reputation as a militant conservative rendered his appointment highly unpopular with the parliament, and the number of his enemies was increased when, in a committee meeting of Sept. 30, he casually remarked that important problems had to be solved by iron and blood not by words and votes. When the parliament persisted in its refusal to grant the budgetary increases Bismarck carried out the military plans without a budget and without the consent of the lower house. He argued that since the upper and lower houses were unable to unite on a policy, the government had a legal right to proceed on its own initiative until agreement should have been secured. The press was restricted and strong measures to repress the opposition taken. Bismarck drew still more fire from the liberals in 1863 when he offered Prussia's services to the Tsar to help him down the Polish Insurrection of 1863.

Meanwhile the stage had been set for the three wars which led to the unification of Germany: the Danish War, 1864; the Austrian or Seven Weeks' War, 1866; and the Franco-Prussian War, 1870-71. In each case Bismarckian diplomacy was able to isolate the enemy and make Prussia appear as the champion of German rights. The success of the minister-president's policies was signalized by the Proclamation of Jan. 18, 1871 whereby King William of Prussia became German Emperor and sovereign over a region which included all the German-speaking peoples of Central Europe save the Austrians, but which also included sizable minorities of Danes, Poles, and Alsace-Lorrainers. See GERMANY, HISTORY OF.

As first chancellor of the new empire Bismarck consolidated the country economically, socially, and politically, and built up a strong, prosperous, and patriotic state. Simultaneously he strove to gain foreign security, particularly against a possible French war of revenge, by building up a system of alliances with Russia, Austria-Hungary, Italy and some of the Balkan states. The desire to avoid needless administrative expenses, to keep German capital at home as long as this was necessary, and to retain the friendship of England, induced him to refrain from an active colonial policy until about 1884. Then he proceeded to push expansion with his accustomed vigor. Naturally his policies met with opposition both at home and abroad. He had serious conflicts, first with the Catholics and states' rights advocates in the so-

called *Kulturkampf*, then with the Socialists, and finally with his own Junker class. He found it increasingly difficult to keep the French republic diplomatically isolated. See GERMANY, HISTORY OF.

Under William I and then under Frederick III, who ascended the throne in 1888 and died in the same year, Bismarck controlled the government. Matters were different when the young, ambitious, and self-confident William II came to the throne. Neither William II or Bismarck cared to play a subordinate rôle, and thus conflict was inevitable. Eventually they quarreled seriously over the question of renewing the anti-Socialist laws and over the right of subordinate cabinet ministers to have direct access to the ruler. On Mar. 18, 1890 after repeated hints from the emperor Bismarck handed in his resignation. This was accepted on the 20th, the emperor simultaneously conferring upon the retiring chancellor the titles of Duke of Lauenburg and Colonel-General of Cavalry.

Bismarck retired to Friedrichsruh whence he continued to manifest a lively interest in political affairs. He was ever ready to grant newspaper interviews, and took delight in criticizing the policies of his successor Caprivi. In 1891 he was elected to the *Reichstag* from Hanover and accepted the honor without, however, taking his seat. In 1893 he refused reelection. Caprivi's successor, Hohenlohe, was on better terms with Bismarck, and in 1894 the latter visited Berlin. The emperor returned the visit to Friedrichsruh. The "iron chancellor's" eightieth birthday was celebrated with elaborate ceremonies throughout Germany in 1895. Three years later, July 30, 1898, Bismarck died in Friedrichsruh. On the stone slab which marks his last resting-place at Friedrichsruh there is engraved one word: Bismarck.

W. C. L.

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**BISMARCK**, the capital of North Dakota, and the county seat of Burleigh Co., situated in the southwestern central part of the state, on the Missouri River. Bus and truck lines and two railroads afford transportation. There is a municipal airport. Bismarck is surrounded by a rich agricultural district. Lignite coal is mined in the vicinity. The city is a shipping point and supply center for the farming region, the military post and the United States Indian agencies of the state. The retail business in 1929 amounted to \$10,213,739. Verendrye came to these parts, probably in 1738. Lewis and Clark spent the winter of 1804-05 here or near here. Bismarck was settled about 1870, incorporated 1875, became the territorial capital in 1883 and the state capital in 1889.

Bismarck is the seat of a United States Indian School for Girls. Near by are the North Dakota State Penitentiary and Ft. Lincoln Military Reservation. Pop. 1920, 7,122; 1930, 11,090.

**BISMARCK ARCHIPELAGO**, a group of about 100 islands lying north and northeast of New Guinea and comprising a total area of 20,000 sq. mi. The largest is New Britain, with an area of 10,000 sq. mi. Other important islands of the Archipelago are New Ireland, Lavongai and the various groups known as Admiralty Islands, Mussau, Gardner, Niguria, Vitu, Umboi, Hermit, Ninigo, Kaniet and Sea Islands. Most of them are of volcanic origin, with summits rising to 7,000 ft. above the water. The slopes of the summits are heavily wooded and the valleys are highly productive, growing cotton, cocoa, coconuts and coffee. The chief towns are Rabaul in New Britain and Nusa and Kavieng in New Ireland. The group was known as the New Britain Archipelago until 1884, when a German protectorate was declared over them and the collective name changed to Bismarck Archipelago. By the Treaty of Versailles in 1919 they were taken from Germany and mandated to Australia with British New Guinea. The native population of the Archipelago in 1929 was 129,074.

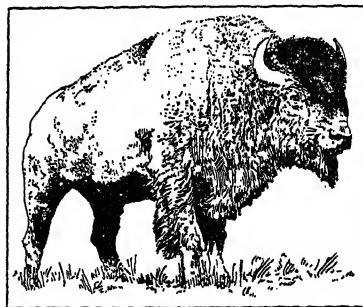
**BISMUTH**, a metallic element (Symbol Bi, at. wt. 209.0) of the same group as arsenic and antimony. It was probably discovered in ancient times, but was confused with tin until 1450. Bismuth is found as a trioxide, trisulphide, combined with carbonic acid and alloyed with tetradyomite; but its principal source is in the free state associated with other ores. It is obtained by re-melting roasted handpicked ore with niter, which forms a solid slag on the surface and leaves practically pure bismuth underneath. Bismuth is a brittle, grayish-white, crystalline metal with a red tinge. It does not tarnish rapidly unless heated. It melts at 270° C. and expands upon solidification; is a poor conductor of heat and electricity. It is used widely in alloys with low melting points, as those employed in automatic fire sprinkler systems. The nitrate of bismuth is used as a flux in enamels, for glazing porcelain, and in cosmetics.

As a metal it is used only slightly in medicine; its salts, however, find a wide variety of uses. Bismuth preparations, particularly the *sodium bismuth tartrate* and other complex bismuth tartrates have been much used in the treatment of syphilis, particularly by intramuscular injection.

**Bismuth Subcarbonate**, a basic bismuth carbonate of varying composition, occurring as a white, odorless, tasteless powder, insoluble in water. It is used as a protective and healing agent for wounds, diarrhea, to allay vomiting, and in X-ray work. It is preferred to bismuth subnitrate.

**Bismuth Subnitrate**, a basic bismuth nitrate similar in appearance and action to bismuth subcarbonate, but may be poisonous under certain circumstances, due to the presence of the nitrate radical. It is used for diarrhea, vomiting and other gastric disorders.

**BISON**, a member of a wild ox group of which only two species still exist, the European wild ox (*Bison bonasus*) and the American bison (*B. americanus*), commonly called the buffalo. The European



AMERICAN BISON

species, once common, appears to have been exterminated except for about 60 kept in reservations and zoological parks. This animal is larger than the American bison, standing 6 ft. at the shoulder with a body length of 10 ft. The forehead, neck, shoulders and hump are covered with long hair.

The American bison, like its European cousin, has 14 pairs of ribs, which differentiates it from other members of the ox family. The hump is more pronounced than in the European animal and the hind quarters are lower and weaker. It has a shaggy mane and horns which are shorter, thicker and more sharply curved.

Bison, typical grazing animals, at one time roamed the western prairies in countless numbers. It is estimated that between 1870 and 1900 over 2,000,000 were slaughtered yearly, most of them killed by buffalo robe hunters who took the skins, leaving the carcasses unused. To-day, due to careful preservation of the remnants of the western herds, there are several thousand bison in various game preserves and national parks in the United States and Canada. A herd of about 1,000 wood buffalo still live wild in a reservation in the territory south of Great Slave Lake.

**BISPHAM, DAVID SCULL** (1857-1921), American baritone, was born in Philadelphia, Pa., Jan. 5, 1857. He studied in Florence in 1886-90, and made his debut in London in 1891. His interpretation of Kurwenal in *Parsifal* established his reputation as an opera singer. In 1896-1909 he sang at Covent Garden, London, and at the Metropolitan Opera, New York, and was considered a Wagnerian baritone of the first rank. He was equally successful on the concert stage where he introduced English translations of foreign songs. He died at New York, Oct. 2, 1921.

**BIT**, the cutting end of a drilling tool. When drilling for blasting in mining and quarrying, hand drills usually have a chisel cutting edge, while machine drills use cross shaped or star shaped cutting edges. In rotary drilling or boring, diamond drills use an annular steel bit set with BORTZ or CARBONADOS while shot drills use the revolving annular bit to press chilled steel shot against the rock. Other types of drills use



fish-tail, auger-like, and V-shaped bits, and some use serrated cones or discs for cutting tools. *See also* DRILLING.

**BITOLJ.** *See* MONASTIR.

**BITTER, KARL** (1867-1915), American sculptor, was born at Vienna, Austria, Dec. 6, 1867. He studied at Vienna and when 22 came to America. Here his facile talent was immediately recognized when he won the competition for the Astor memorial gates in Trinity Church, New York. In his short life he produced a great number of works in both marble and bronze, including statues of Franz Sigel and Carl Schurz, and decorative sculpture for commercial buildings. He was director of sculpture for the Pan-American Exposition in 1901, and in 1904 of the St. Louis Exposition, to which he contributed his Louisiana Purchase group. Bitter died at New York, Apr. 10, 1915.

**BITTER ALMONDS, OIL OF.** *See* BENZALDEHYDE.

**BITTERN**, the common name for a genus (*Botaurus*) of small or medium-sized birds of the heron family. They differ from the true herons in having



G. M. SUTTON. "BIRDS OF PA."  
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AMERICAN BITTERN

shorter, thicker necks, larger heads and streaked or mottled brown and black plumage. The bitterns inhabit swamps and wet meadows where they live in a very solitary manner, often sitting motionless for hours concealed amid the vegetation. They subsist chiefly upon fish, crustaceans, frogs and insects and build a loose nest on the ground, laying three to five brownish or bluish-white eggs. The American bittern (*B. lentiginosus*), or stake driver, a bird about 2 ft. in length, with a pec-

uliar booming cry, is found almost throughout temperate North America and ranges southward to Guatemala. The least bittern (*Ixobrychus exilis*), a closely related bird scarcely more than a foot long, has an even more extensive range.

**BITTERNUT.** *See* HICKORY.

**BITTERROOT** (*Lewisia rediviva*), a low perennial of the purslane family, found widely in the mountains of western North America. It is an almost stemless plant, with a thick root, producing at the ground a circle of fleshy leaves from which arises a short flower stalk bearing a single, many-petalled, rose-colored flower, 2 in. or more across. In early spring this handsome wild-flower often colors vast areas with its roseate bloom. So profuse and popular is this plant in Montana that it gave its name to the Bitterroot Mountains and the Bitterroot Valley, and is the state flower. The Indians, who used the starchy roots for food, called the plant spatum. It

was first collected by Captain Meriwether Lewis, of the Lewis and Clark Expedition, whence the botanical name *Lewisia*.

**BITTERS**, alcoholic beverages flavored with bitter substances, such as rhubarb, quinine, angostura, camomile, gentian and orange rind. Their method of preparation is similar to that of liqueurs. Most of them contain about 40% alcohol. Some of them are used for medicinal purposes and some as beverages. The name usually suggests the flavoring, as peach, orange or angostura bitters.

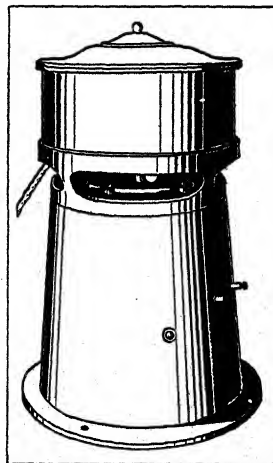
**BITTERSWEET** (*Solanum Dulcamara*), called also woody nightshade, a climbing perennial of the nightshade family, native to the Old World and widely naturalized in North America. The slightly woody stem bears dark green, mostly heart-shaped leaves, loose clusters of purple flowers, resembling those of the potato, and brilliant scarlet, poisonous berries. Chewing the leaves produces first a bitter and then a sweet taste. The dried young branches are used in medicine.

**BITTERSWEET, CLIMBING** (*Celastrus scandens*), called also waxwork, a vine-like shrub of the staff-tree family, found on banks and in thickets from Quebec to Manitoba, southward to North Carolina and New Mexico. It climbs trees, sometimes to a height of 25 ft., bearing finely toothed, long-pointed leaves, and small greenish flowers in terminal clusters. The bright yellow and scarlet fruits, which persist long after the leaves have fallen, make highly ornamental autumn and winter decorations.

**BITUMEN**, the name of a group of natural hydrocarbons varying from PETROLEUM through the mineral tars to ASPHALT. It is usually restricted to the viscid tars, pitch and asphalt, which find their main use in paving, in the manufacture of prepared roofings, paints, varnishes, insulators and in substitutes for rubber. Asphalt occurs in lake-like deposits in Trinidad and Venezuela, and is also manufactured from petroleum.

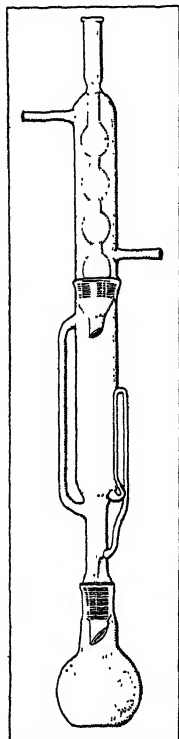
**BITUMEN EXTRACTION TESTS** are made on bituminous construction materials such as shingles, roofing paper, expansion joints, and bituminous pavement mixtures to determine their composition. The binding material is the contained bitumen.

Once the bitumen is dissolved (*see* ASPHALT TESTING, *Bitumen Content*) the remainder of the material may be further examined or analyzed. Bituminous paving mixtures are treated in either the Dulin Rotarex or the New York Testing Laboratory (NYTL) hot extraction apparatus; the other materials in a Soxhlet ap-



COURTESY EIMER & AMEND  
DULIN ROTAREX FOR EXTRACTING BITUMEN

paratus. In the Rotarex the bitumen is dissolved and then thrown out of the vessel by centrifugal force through a piece of filter paper. In the NYTL apparatus the sample is placed in a basket suspended over a supply of the solvent, which is heated. The vapors are condensed above the sample and the drops pass through the sample dissolving out the bitumen. This test is normally run over-night while the Rotarex test may be completed in an hour. In the glass Soxhlet apparatus the sample is placed in a filter tube, which is then placed in the syphon unit. The solvent is placed in the flask and heated. The vapors rise through an outside tube to the condenser unit where they are condensed and drop down on the sample. The solvent is collected in the syphon unit until the sample is completely immersed and then is siphoned back into the lower unit and the cycle started all over again. The bitumen is completely removed in this way. E. E. B.



COURTESY EIMER & AMEND  
SOXHLET USED IN  
THE EXTRACTION  
OF BITUMEN

**BITUMINOUS MACADAM**, an evolution from waterbound MACADAM which does not wear well under high-speed rubber-tired traffic due to the quick removal, by "suction," of the fine water-bound dust providing the binding element. In bituminous macadam the larger stones are held in place by a binder of BITUMINOUS MATERIALS. By the "penetration" method, this binder is sprayed under pressure on the rolled stone. By the "mixing" method it is applied to the stone before the stone is spread. The binder may be applied hot, or as a cold "cut back" asphalt or tar made fluid by the addition of a volatile compound, such as NAPHTHA, which later evaporates. Asphalt-water emulsion, hardening with the loss of water, are also used successfully. Such surfaces are from two to three inches thick and are finished with a "seal coat." See also SURFACE TREATMENT.

**BITUMINOUS MATERIALS**, a term covering substances composed of or containing PETROLEUM, ASPHALT or TAR, and such portion of these materials as will dissolve in CARBON BISULPHIDE.

ASPHALT is a natural constituent of many crude petroleum. It is a black to dark brown semisolid or solid cementitious product which melts when heated, and may be recovered from petroleum (see PETROLEUM REFINING) by distilling off the oils which hold it in solution. Liquid asphaltic products of any viscosity may be produced by stopping DISTILLATION at an appropriate point. See also BITUMINOUS MACADAM.

In numerous instances, natural processes have produced deposits termed "native" asphalt. When the

native asphalt has been formed within a porous rock structure, such as sandstone or limestone, the rock is known as "rock asphalt."

TAR is a black to dark brown liquid produced by destructive distillation (see DISTILLATION, DESTRUCTIVE) of organic material, such as COAL, oil, LIGNITE, HEAT, and wood. The greatest quantity of tar is produced from BITUMINOUS COAL in the manufacture of COKE and ILLUMINATING GAS. Tar contains a product known as PITCH, which may be recovered by distilling off the oils that hold it in solution. Liquid tar products of any desired VISCOSITY may also be produced in the same general manner as liquid asphaltic products.

Bituminous materials are most extensively used in the construction and maintenance of roads and pavements. Large quantities are also employed in the manufacture of roofing materials and for waterproofing purposes. They are also used in the manufacture of paints, enamels, japans, varnishes and lacquers, electrical insulating products, anti-acid coatings, waterproof wrapping and for sheathing paper, flooring compositions and mastics.

For HIGHWAY purposes, the liquid products are used mainly in the surface treatment of EARTH ROADS, SAND-CLAY ROADS, GRAVEL ROADS and MACADAM ROADS (see BITUMINOUS MACADAM), and are applied cold or hot, depending upon their viscosity. The very fluid products are used as "dust layers" or as "primers" to prepare the road surface to receive application of more viscous products which will combine with a cover of stone chips or gravel to produce a wear resistant "bituminous mat."

Relatively soft asphalt cements and highly viscous refined tars are used in the construction of bituminous macadam roads, by what is known as the "penetration method." The harder grades of asphalt cement are used in the construction of hot mix pavements known as asphaltic concrete, sheet asphalt, and also in the manufacture of asphalt block. Asphalt and tar products are used in the construction of various types of cold mix pavements and as crack and joint fillers for brick, stone block and Portland cement concrete pavements. See also CONCRETE ROADWAYS; ASPHALT PAVING. P. H.

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**BIZERTA**, a city and seaport of Tunis, Africa, on the Mediterranean coast, situated on the outlet of a lake which bears its name; the town of Tunis lies 60 mi. to the southeast by rail. It has a fine harbor, with a depth of over 35 ft., which is connected with the sea by a canal. Strategically, Bizerta with its naval station, fortifications and arsenals, is of great value to France. Its lagoon has thriving fisheries and there is some trade in olive oil and cereals. Pop. 1926, 20,593; 1931, 27,000.

**BIZET, ALEXANDRE CÉSAR LÉOPOLD** (known generally as Georges Bizet) (1838-75), French composer, was born at Paris, Oct. 25, 1838. Entering the Paris Conservatory at the age of nine, he

remained there for ten years, winning the Prix de Rome. His early operas, *Don Procopio*, *Les Pêcheurs de Perles* and *La Jolie Fille de Perth*, found little public favor, but his *L'Arlésienne suite* quickly found public favor, while his opera *Carmen*, although coldly received at its first production three months before the composer's death, eventually made his name known throughout the musical world. In 1869 he married Geneviève Halévy, daughter of JACQUES HALÉVY, composer of *La Juive*, under whom Bizet studied at the Conservatory. He died at Bougival, near Paris, June 3, 1875.

**BIZZEL, WILLIAM BENNETT** (1876- ), American educator, was born at Independence, Tex., Oct. 14, 1876. In 1898 he graduated at Baylor University and from 1900-10 was superintendent of public schools at Navasota, Tex. He was president of the College of Industrial Arts, Denton, 1910-14, and of the Agricultural and Mechanical College of Texas from 1914-25, and became president of the University of Oklahoma in July 1925. Bizzel is the author of *Farm Tenantry in the United States*, 1921; *Rural Texas*, 1923, and *The Green Rising*, 1927.

**BJÖRNSON, BJÖRNSTJERNE** (1832-1910), Norwegian writer, was born at Kvikne, Dec. 8, 1832, the son of a parish priest. He attended the Molde Grammar School and began to write at an early age, writing his first play while a student at the University of Christiania. He left the university without a degree, and in 1857 became director of the theater in Bergen. His play *Mellum Slagene*, or *Between the Battles*, was produced in 1857, in which year his first novel, *Synnøve Solbakken* also appeared. Bjørnson traveled on the Continent from 1860-63, and was director of the theater in Christiania from 1865-67. He was a prominent figure in Norwegian society and politics; he visited Paris frequently and in 1880-81 lectured in the United States. His early novels deal with Norwegian peasant life, and include *Arne*, 1858, *A Happy Boy*, 1860, *The Fisher Maiden*, 1868, and, to a less extent, *The Bridal March*, 1873. His later works, among which are *Flags Are Flying in Town and Harbor*, 1884, and *In God's Way*, 1889, were experimental and somewhat confused. As a poet Bjørnson wrote many lyrics and also an epic poem, *Arnljot Gelline*, 1870. He was the author also of numerous dramas, the earliest of which were based upon the sagas. His best known dramas are *Lame Hulda*, 1858, *King Sverre*, 1861, the great trilogy entitled *Sigurd the Bastard*, 1862; and, of the later period, *The Editor*, 1874, *A Bankruptcy*, 1875, *The New System*, 1879, and *Beyond the Strength*, 1883. In 1903 Bjørnson was awarded the Nobel Prize for Literature. With the exception of HENRIK IBSEN, he is undoubtedly Norway's most important man of letters. He died in Paris, Apr. 26, 1910. See also SCANDINAVIAN LITERATURE.

**BLACK, JEREMIAH SULLIVAN** (1810-83), American statesman and lawyer, born near Stony Creek, Pa., Jan. 10, 1810. Admitted to the bar in 1831, he became a famous pleader and, in 1851, was

elected to the State Supreme Court, of which he was chief justice for three years. President Buchanan appointed him to his Cabinet as Attorney-General in 1857. Although extremely eccentric in appearance and habits, being known as a "character," Black was respected for his clear reasoning and sound judgment in handling complex problems, such as the California land-title cases. As Secretary of State from December, 1860, till March, 1861, he vigorously opposed the secessionist movement and urged stronger Federal fortifications throughout the South. He helped revise the Pennsylvania constitution in 1872, and thereafter devoted himself to his law practice. He died at York, Pa., Aug. 19, 1883.

**BLACK AND TAN REPUBLICANS**, in the southern states, that faction of the Republican party which accepts and includes Negro voters. See LILY-WHITE REPUBLICANS.

**BLACK AND TANS**, a group of armed men appearing in Ireland in June 1920 to augment the ranks of the Royal Irish Constabulary depleted by resignations because of the "war" inaugurated in January by Daniel Breen and his Tipperary followers. The new force, recruited from demobilized British troops, was named because of its unorthodox uniform in which the dark green of the constabulary was combined with the khaki of the army. The Irish irreconcilables were waging an aggressive campaign against England. Police were assaulted and shot; informers were murdered; barracks were sacked and burned; arms were stolen. And Britain retaliated by terror on a large scale.

The Black and Tans engaged in reprisals both "official" and unofficial to coerce the 2,000 or more gunmen who supported Breen. Houses were burned, creameries held to be meeting places of conspirators were destroyed, prisoners were shot "while attempting to escape," and despite the protests of the Archbishop of Canterbury and many liberals the war of attrition continued. Most of the civil population of Ireland had opposed the practices of the radical republicans; but the activity of the Black and Tans caused many to offer passive resistance to Britain. Negotiations between responsible Irishmen and British officials finally culminated in the treaty of 1921 which set up the Free State. It was agreed that compensation should be paid English officials who retired from Ireland; but the Black and Tans were specifically deprived of this benefit.

**BLACKBERRY**, the common name for various brambles of the ROSE FAMILY. The biennial stems arise from perennial roots, bear fruit during their second summer and die before the following spring. The English bramble, often called blackberry, is a semi-evergreen plant tender to frost but grown to some extent in Pacific coast home gardens for ornament and for its large, sweet berries. Its best known variety, Oregon Everbearing, has attracted considerable interest. Unlike varieties of other species, its canes often live for several years and may become 2 in. thick and hold their green leaves well into winter. With

this and a few other exceptions, all blackberries cultivated in America are natives of this continent. They began to attract attention only during the middle of the 19th century and since then several hundred varieties have been listed by nurserymen and pomologists. Blackberry growing has developed from home garden status to commercial importance, an outstanding example of the potentialities of American native fruits.

Blackberries naturally propagate by seeds and suckers, which spring from the roots. The former produce fruit of such variable value that they are used by man only for the origination of new varieties. As some varieties produce very few suckers nurserymen employ root cuttings to grow plants in large quantities.

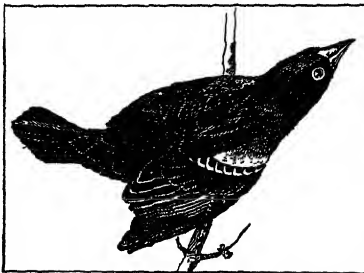
Although some varieties may be grown in home gardens in many parts of the temperate zone and on various types of soil, their commercial planting is safest where the winters are not so severe as to kill the stems, and where hot, dry summers will not reduce the berries to little flavorless bunches of seeds. In a well-drained, deep, mellow clay loam, richly supplied with humus, blackberries produce large, luscious, ebony-black fruit which is delectable when "dead" ripe.

M. G. K.

**BLACKBIRD**, the name given in North America to various black-plumaged birds belonging to the same family (*Icteridae*) as the orioles and meadow larks. In habit they are distinctly social, often moving in very large flocks and nesting in communities, often in marshes. Although occasionally causing damage to the grain in cultivated fields, they feed chiefly upon weed seeds and injurious insects.

The largest blackbirds are those known as grackles or crow blackbirds (*Quiscalus*), species of which are found practically throughout the United States and southern Canada, occurring most abundantly in the eastern states. The various species range from about 11 to 18 in. in length and have black plumage glossed with green, purple or bronze.

Of the smaller species, none are larger than a robin. The red-winged blackbird (*Agelaius phoeniceus*), with deep black plumage marked with red and buff



RED-WINGED BLACKBIRD (YOUNG MALE)

on the shoulders, is common east of the Great Plains. In Oregon and California there are two closely allied forms, the tricolored blackbird (*A. tricolor*), with red and white on the shoulders, and the bicolored blackbird (*A. phoeniceus californicus*), with a plain red shoulder patch. The yellow-headed blackbird

(*Xanthocephalus xanthocephalus*), with the head, neck and chest orange-yellow, ranges from British Columbia to the Hudson Bay and southward to Mexico.

Common about dwellings in western North America is Brewer's blackbird (*Euphagus cyanocephalus*), with glossy blue-black plumage and a purplish head. The rusty blackbird (*E. carolinus*), glossy black all over but in winter marked with rusty brown, breeds from northern Canada and Alaska to the northern United States and winters southward to the Gulf coast.

In the British Isles, the ouzel or merle, an Old World species of thrush (*Turdus merula*), with a rich mellow song, is commonly known as blackbird. See also GRACKLE; OUZEL. A. B. J.

**BLACK BODY RADIATION.** If a beam of light falls upon a mirror or polished metal surface, nearly all of it is reflected (see REFLECTION), while if it falls on a piece of black velvet or a metal surface painted a dull black, almost none of it is reflected. If two metal cubes, one polished and the other painted a dull black, are placed side by side in a beam of sunlight it will be found that the temperature of the black cube will rise more rapidly than that of the other. That is, the black cube absorbs (see ABSORPTION OF LIGHT) and converts into heat most of the energy of the sunlight, reflecting very little of it. The polished cube, however, reflects most of the energy incident upon it and absorbs very little. Suppose that we now heat both cubes to the same temperature, one considerably above that of their surroundings, as, e.g., by immersing them both in boiling water for a few minutes. If they are now placed side by side in the air we shall find that the black cube cools more rapidly than the other. That is, it radiates (see RADIATION) its heat more rapidly than does the polished cube.

This behavior depends primarily upon the condition of the surfaces. Smooth, bright, polished surfaces are good reflectors and therefore poor absorbers and poor radiators. Black, dull, rough surfaces are good absorbers and good radiators, but they are very poor reflectors. Some substances show selective reflection or selective absorption. For example, gold is yellow because it reflects yellow light but absorbs the other colors. Similarly, rock salt strongly reflects certain wave-lengths of the infra-red, or heat, rays but absorbs others.

The technical definition in physics of a black body is a body which absorbs radiation of all wave-lengths completely and reflects none. Such a body is also a perfect radiator. That is, a black body at any given temperature radiates energy of all wave-lengths, and the rate at which it radiates energy of any particular wave-length is at least as great as that at which any other body at the same temperature radiates it. All this is usually expressed by saying that a black body is a perfect absorber and a perfect radiator.

Careful experiments have shown that no actual body satisfies this definition, although any dull, black, metal surface fulfills it approximately. Nevertheless, ap-

paratus can be constructed which will radiate energy exactly as a black body would. Imagine a closed box, the walls of which are heated to a uniform temperature. After a time the box and its interior will be in thermal equilibrium. If now we open a very small hole into the box, the radiation from the interior can be shown to be identical with that from a perfect black body at the same temperature. Also, the hole will absorb energy of all wave-lengths completely, just as a black body does. The radiation from the interior of a long, narrow, cylindrical electric furnace, equipped with suitably graduated diaphragms, meets these specifications accurately. Such a furnace is called an experimental black body. The radiation from the interior of a narrow, uniformly heated wedge of platinum foil is also black body radiation.

The concept of a black body is very important in the study of radiant energy because its behavior depends only on its temperature, and the radiation laws apply accurately to it but only approximately to other bodies. These radiation laws are STEFAN'S LAW, sometimes called the Stefan-Boltzmann law, WIEN'S LAW and PLANCK'S LAW. Aside from their importance in theoretical physics, the black body radiator and the radiation laws are of great practical value because of their applications in PYROMETRY.

W. W. S.

**BLACKBUCK** (*Antelope cervicapra*), a small gazelle-like antelope native to the central plains of India, where it gathers at times in great herds. The males are blackish brown above, and white in the ventral surfaces. The long lyrate horns are carried as a badge and defensive weapon by certain classes of fakirs. The blackbuck is a favorite game animal for sportsmen, and is the special prey of the cheetah.

**BLACKBURN**, a municipal and county borough of Lancashire, England, situated in the beautiful valley of a stream once called the Blackeburn, the modern Brook, 210 mi. northwest of London. The town is of great antiquity, flourishing as a market center in Elizabethan times, and famous from the 17th century for its checks and Blackburn greys, both linen and cotton fabrics. James Hargreaves invented his spinning jenny, about 1764, while employed in the large local factory of Robert Peel, grandfather of the prime minister. The parish Church of St. Mary, now a cathedral, is on a much earlier site, and there are well-planned parks, an Elizabethan grammar school in modern buildings and many public foundations. The vicinity is rich in lime, building stone and coal, but although there are local collieries, Blackburn still specializes in cotton weaving. Pop. 1921, 126,922; 1931, 122,695.

**BLACKCAP**, a name given to various birds with conspicuously black plumage on the top of the head, especially to an Old World warbler (*Sylvia atricapilla*), scarcely inferior to the nightingale as a song bird. It breeds almost throughout Europe and also in western Asia and North Africa, sometimes wintering as far south as Gambia and Abyssinia. The blackcap is a rather slender bird, about the length of an Eng-

lish sparrow, grayish above and white below, with the top of the head jet black. It builds, usually in low bushes, a compact nest lined with horsehair, laying four or five yellowish-brown eggs. Two broods are reared during the season, the male taking his turn at incubation. The food of the blackcap consists chiefly of insects and berries. In the United States Wilson's warbler (*Wilsonia pusilla*) and the chickadee are sometimes called blackcap. See also CHICKADEE; WARBLER.

**BLACK COCK**, the name applied to the male black grouse (*Lyrurus tetrix*), a famous game bird of the Old World, the female being known as the grayhen. This species, found extensively in Europe and Asia, inhabits birch and pine forests and also more open country, feeding upon seeds, grain, buds and berries. The male, about 2 ft. long, and bluish-black in color with white markings on the wing, has feathered legs and a conspicuously outcurved tail; the female, which is much smaller, has striped and spotted brownish plumage. In the spring the cock seeks to attract a mate by performing curious antics, at the same time uttering cooing or drumming cries, and battles furiously when rivals appear. The black cock is polygamous and not infrequently mates also with the capercaillie and pheasant. A scantily lined hollow under a tree or low bush constitutes the nest, in which are laid six to ten yellowish, brown-spotted eggs.

**BLACK DEATH**, the name given the famous outbreak of bubonic plague which, originating in Asia in 1346, appeared in Constantinople, Sicily, Genoa, Naples and Marseilles in 1347, and during the two succeeding years swept through Europe and portions of Africa and southern Asia. It was at its height in Italy and southern France from Jan. 1348 throughout the year; in Spain, parts of southern Germany, northern France and England, from the summer of 1348 till the summer of 1349; in other sections of the British Isles and of Germany, in Switzerland, Hungary, Poland and Scandinavia, chiefly in 1349; and in regions of north Germany, in Iceland, Greenland and Russia, late in 1349 and in 1350. Succeeding outbursts of the plague occurred in Europe almost every year of the latter half of the century, the epidemics of 1372, 1382, 1388 and 1398 being especially notable; and they were constantly recurrent through the next three centuries. Not until the 17th century is the name Black Death, *atra mors*, to be found applied to the 14th century pestilence; contemporaries called it "the pestilence," "the pestilence of the groin," "the pestilence with buboes," "the great mortality." (See PLAGUE.)

**Causes of Disease.** Writers of the time describe the symptoms, the course of the disease and its causes. Distinction is made between the pneumonic and the bubonic types: the former usually precedes in a given locality, is accompanied by blood-spitting, and has a speedy fatal termination; the latter manifests itself in buboes behind the ears, in the armpits, and in the groin, runs its course more slowly, but is almost as deadly. The causes were considered to have been:



first, astronomical, with constant corruption of the air; second, terrestrial, when corruption of the air is caused by earthquakes, stagnant bodies of water, or masses of fetid organic substance; and, third, infection, contagion and accumulation within the body of poisonous matter whereby heart and lung are overburdened, and life is extinguished. Poisoning of wells, or of the air, by Jews was an alleged cause among the populace, giving rise to terrible Jewish persecutions.

The epidemic brought about improvements in prophylaxis, hygiene and sanitation. Disinfectants were recommended and cleanliness of houses and streets urged; the practice of quarantine was first established in the latter part of the 14th century. Writers of the two succeeding centuries asserted that law had been affected by the pestilence, the amount of litigation being greatly increased.

**Far Reaching Results.** The results of the Black Death were far-reaching and catastrophic. Socially and economically, it dealt a powerful blow at the existing agrarian and industrial organization, producing a sudden rise in the cost of commodities and of labor. Even Governmental regulations, like the Statute of Laborers, failed to bring the working classes back to their former status; and the JACQUERIE of 1358 and WAT TYLER'S REBELLION of 1381 menacingly demonstrated the discontent and new demands of the lower classes. The effect on the Jewish communities of Germany should be included here. Before the pestilence, Ghetto ordinances were laxly enforced, and Jews were allowed to own real property. Afterward the former requirement was strictly emphasized and the latter right withdrawn; so that certain Jewish writers date from 1349 the peculiar homelessness of the race, and their tendency to concentrate on the acquisition of ready wealth.

Universities and schools were hard hit; many endowments and charters were given the former from 1350-70 "to repair the ravages of the pestilence." With this assistance, they seem to have rallied; but the grammar schools apparently never recovered, and not until the last quarter of the 19th century was popular elementary education so well administered. The epidemic is given, however, by a contemporary writer, as the cause of the introduction of English as the language of instruction in English schools. Certainly there was a decided increase in the number of learned works written in the vernacular of various countries. The loss of clergy affected the Church disastrously. Enforced ordination of untrained men, the sudden laxity of morals, and the large number of legacies left the Church are considered by many authorities among the most important causes of the Wycliffite and Hussite movements, and of the Reformation.

A last, and sinister, consequence of the pestilence was the effect upon men's minds. This may be seen in the rise of the FLAGELLANTS in 1349; in the prominence in art, after that date, of morbid subjects such as the dance of death; and in the pessimistic tone of

much literature of the same period. It was probably a more potent factor than is generally realized in succeeding developments in mysticism, Puritanism and persecution.

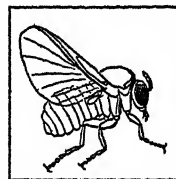
A. M. C.

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**BLACK-EYED SUSAN** (*Rudbeckia hirta*), a handsome biennial of the composite family, the state flower of Maryland, called also yellow daisy and nigger head. It is native to the eastern United States and Canada where it is often found growing profusely in dry fields and sunny open places. The stout stem, covered with bristly hairs and bearing rough hairy leaves, attains a height of two or three feet. At the end of the stems are borne large attractive flowers composed of a central blackish-brown disk surrounded by bright golden-yellow rays.

**BLACKFISH** (*Globoicephalus*), a marine mammal of the dolphin family, several species of which are hunted for their oil. The common blackfish of the Atlantic coast of North America is 15 to 18 ft. long, jet black, with a "sawed off" head, long flippers, and teeth in both jaws. Blackfish travel in large herds. Thousands have been beached on Cape Cod, sometimes as many as 100 in one school. The oil is inferior to that from the sperm whale, though the jaw yields a fine grade of machine-oil. Northern blackfish are called also pilot whales or ca'ing whales.

**BLACK FLY**, a minute, biting fly of the dipterous family *Simuliidae*, called also the "buffalo gnat." It has a curious, hump-backed appearance. It inhabits most parts of the United States and Canada, particularly woods where there are clear flowing streams. The eggs are laid in big patches on rocks or logs at the surface in swift streams, and in about a week, hatch into yellow, brown or black larvae. The larval life is about four weeks, when the larva pupates, emerging from one to three weeks later as an adult fly.



BLACK FLY  
Enlarged

**BLACKFOOT**, or Siksika, a typical Plains Indian group speaking a language of the Algonkian linguistic stock. Formerly they roamed from the prairies of Montana to Canada on the north and to the Rocky Mountains on the west. They now live on reservations in Montana and in Alberta, Canada. The Blackfoot are composed of three politically independent groups: the Blackfoot proper, the Piegan and the Blood, each of which was further subdivided into bands. They were in the past closely affiliated with the SARSI and GROS VENTRE. Like all the other peoples of the Plains, the Blackfoot were a nomadic hunting people, lived in skin tipis, dressed in skins and made no effort at agriculture, pottery or weaving. Their ceremonial and religious life was elaborate; they had the sun dance, a system of age-graded societies for men, and sacred medicine bundles and

personal medicines which centered around well developed rituals.

**BLACKFOOT**, a city in southeastern Idaho, the county seat of Bingham Co., it is situated near the



FROM MAXIMILIAN VON WIED-NEUWIED'S ATLAS

BLACKFOOT INDIAN ON HORSEBACK  
From a drawing by Karl Bodmer

Snake River, 25 mi. north of Pocatello; served by the Union Pacific Railroad and bus lines. Blackfoot is a trade center for a region devoted to potato and sugar beet growing; it is the seat of the state insane asylum and a United States land office. Blackfoot was founded in 1778 and incorporated in 1907. Pop. 1920, 3,937; 1930, 3,199.

**BLACKFOOT DAKOTA**, or Sihasapa, a sub-tribe of the great Teton division of the Dakota Indians, speaking the Teton dialect of the Siouan linguistic stock. This group is now segregated on the Standing Rock Reservation in North Dakota and like the major group were a typical Plains people.

**BLACKFRIARS THEATRE, THE**, the most celebrated of the Elizabethan theaters, built by James Burbage in 1596, in the district of Blackfriars, London. The first completely roofed theater in England, it was used chiefly in winter (*THE GLOBE* in summer) by the company controlled by the Burbages and SHAKESPEARE. Richard Burbage, the foremost actor of his day, achieved his greatest triumphs at the Blackfriars, and there Shakespeare also probably acted. The theater was torn down in 1655.

**BLACK FRIDAY**, Sept. 24, 1869, a hectic day in American finance, on which the price of gold advanced from 145 to 163½, then precipitately fell to 135. Prominent among speculators on the fluctuation of gold were Jay Gould and James Fisk, who were associated in an endeavor to corner the gold supply in the United States. The two bought gold which was immediately lent on demand notes, with the intention of demanding redemption when their activities had forced the price to high levels. To forestall the possibility that the United States Treasury,

to prevent the business depression consequent upon such a coup, might sell gold when the price had reached a peak, Gould assiduously cultivated the acquaintance of President Grant and Secretary of the Treasury Boutwell. But becoming fearful that, despite his acquaintanceship, his "corner" would be broken by the sale of Treasury gold, the financier secretly began to sell his notes, meanwhile encouraging Fisk to continue buying. On Black Friday, in the Gold Room adjoining the New York Stock Exchange, many capitalists were irretrievably ruined in the few hours of rapid fluctuation. Sales by Gould's agent broke Fisk's corner shortly before the Treasury telegraphed to sell \$4,000,000 of its gold. Fisk escaped ruin by repudiating his obligations.

**BLACK GUM**, a name applied in the southern states, especially in the lumber trade, to the *TUPELO* or pepperidge (*Nyssa sylvatica*), a handsome tree of the *nyssa* family widespread in eastern North America.

**BLACK HAW.** See *VIBURNUM*.

**BLACK HAWK MONUMENT**, a noteworthy historical memorial standing on a bluff near Oregon, Ill. The figure of concrete, 43 ft. high, represents an Indian wrapped in a long blanket, standing with arms folded gazing over the scene before him. It was executed by *LORADO TAFT* and intended to be symbolical of the race. As the site was a favorite haunt of the chief, Black Hawk, the statue is called by his name.

**BLACK HAWK WAR**, 1831-32, the outbreak of Sac and Fox Indians under Chief Black Hawk. The Sac village near the mouth of Rock River, Ill., was preempted by white settlers; the majority of Sacs and Foxes followed their Chief Keokuk's policy of non-resistance, and moved to the west bank of the Mississippi. Black Hawk headed an irreconcilable band which threatened forcibly to expel the newcomers, but was persuaded to withdraw. In the spring of 1832 Black Hawk's followers, less than 1,000 men, women and children, recrossed the Mississippi. Black Hawk's frank intention was to cultivate crops on the rich soil of the old village, and in the autumn to enlist the Potawatami and other tribes in Illinois and Wisconsin in a general uprising. His reappearance terrorized the frontier. The Illinois militia were hastily mustered. Messengers sent by Black Hawk under a flag of truce were murdered, but to their own amazement the small band of braves dispersed an overwhelmingly superior number of volunteers in panic. The Indians retreated toward the dells of Wisconsin, and at Bad Axe River were defeated by the reorganized militia. Col. Henry Dodge, nominally in command, arrived too late to check an insensate massacre of the Indian men, women and children. The result was a series of treaties whereby the United States acquired the Indian title to the east bank of the Mississippi, and an acceleration of settlement in Illinois, Wisconsin and Michigan.

**BLACK HILLS**, the name for a group of mountains which lie chiefly in the southwestern part of

South Dakota. Estimates have put their area as high as 9,000 sq. mi. The Black Hills are remarkably rich in gold, lead, tin and other minerals, and have extensive streams and forests. Their average height above sea level is about 3,000 ft., Harney Peak reaching 7,240 ft. On the granite face of Mt. Rushmore, the head of George Washington, 60 ft. high, was carved by GUTZON BORGLUM and unveiled on July 4, 1930. Here also are to appear the heads of Jefferson, Lincoln and Roosevelt, and a brief history of the United States by CALVIN COOLIDGE, the whole to be known as the Mt. Rushmore National Memorial.

**BLACK HOLE OF CALCUTTA**, a tiny cell in Ft. William in which 123 English prisoners suffocated. The viceroy of Bengal stormed Calcutta June 20, 1756. Most of the English escaped; but the viceroy captured 146 persons, some of them women, and imprisoned them in a cell in Ft. William, the citadel, built to hold three men. All but 23 died of suffocation before the cell was opened in the morning. By Jan. 1757 the English had retaken Calcutta and exacted compensation.

**BLACK LEG** or **BLACK QUARTER**, a specific infection of cattle caused by the *Bacillus Chauvei*, the organism entering the body through wounds in the legs or feet. The first symptoms are localized swellings on the legs, shoulders, flank or loins, followed by general debility, high temperature, rapid pulse and lameness. The swellings increase and become painful and when opened are found to contain a foul reddish pus. Treatment is seldom of any value and the disease is usually fatal. Immunity to healthy animals may be given by a subcutaneous inoculation with a vaccine derived from the infecting organism.

**BLACK LISTS**, memoranda kept by employers, listing the names of employees whom they consider undesirable because of participation in labor agitation, strikes or other trade union activities. They are the employers' counter weapon to the Boycott. Such lists are often circulated among employers not only within an industry, but also in other industries and in other localities. By tacit agreement employees so listed are refused employment. Some employers prefer "white lists" listing workers who are tractable, faithful and efficient. Such workers are sometimes given clearance cards and receive preference in employment. The white list corresponds to the fair list and the label used by trade unions. (See LABOR ORGANIZATIONS.) Both black and white lists have the same purpose—discrimination against workers considered undesirable. The fear or hope of listing is often an effective deterrent to participation in industrial disputes.

Attempts at statutory legislation against black listing have been unsuccessful because of difficulty in producing incriminating evidence. Such laws would obviously be practically impossible of enforcement because of the facility of making secret agreements. The courts have declared that employers have a right to keep a record of men discharged for union mem-

bership and that they may lawfully invite inspection by other employers. P. F. B.

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**BLACKMAIL**, obtaining something valuable from another by threatening to expose or otherwise reveal something he desires kept secret. The word started (*black* and *mail*, or tribute) with the payment to bands of marauders on the borders of England, to obtain from them security and protection. The use is broader now. One pays to secure personal safety, property protection, concealment of a crime, or even suppression of matter tending to bring ridicule and disgrace. In some states, the law regarding blackmail and EXTORTION is practically synonymous, consequently in criminal practice (see CRIMINAL LAW), the statutes and codes set forth the technical procedure followed in each state.

**BLACKMORE, RICHARD DODDRIDGE** (1825-1900), English novelist, was born at Longworth, Berkshire, June 7, 1825. He graduated at Exeter College, Oxford, in 1847, studied law and practiced a few years before devoting his entire time to literature and the management of a market garden and orchard at Teddington-on-the-Thames. His first novel, *Clara Vaughn*, published in 1864, was well received, but his greatest success was LORNA DOONE, a 17th century romance noted for its beautiful descriptions of the English country. *The Maid of Sker* and *Alice Lorraine* are among Blackmore's other novels. He died at Teddington, Jan. 20, 1900.

**BLACK MOUNTAINS**, a chain of lofty peaks in western North Carolina, situated in Buncombe and Yancey counties. They cover an area 15 mi. long from north to south and about 5 mi. wide, in which there are 13 summits exceeding 6,000 ft. in height. The predominating one is Mt. Mitchell or Black Dome (see MITCHELL, MOUNT) which attains 6,711 ft. and is the highest peak in the United States east of the Rocky Mountains. Other noted summits in this group are Balsam Cone, 6,671 ft., Black Brothers, 6,619 ft., Cattail, 6,611 ft. and Chimney Mountain 6,234 ft. Structurally this chain is a spur of the Blue Ridge, a part of the Appalachian system, but its general trend is almost at right angles to the Blue Ridge. It has a complex formation composed of a plateau surface of considerable elevation on which the individual ridges appear to be implanted. Their slopes are so heavily wooded with evergreens and underbrush as to give the general appearance of a jungle, and especially on Mt. Mitchell the growth of rhododendron is often impenetrable. The crest line forms the divide between the Tennessee and Catawba river systems. The Black Mountains got their name from the fact that the wooded domes of the peaks appear black when viewed from a distance. Asheville, N.C., a celebrated resort, lies about 50 mi. east of this range.

**BLACKPOOL**, a municipal and county borough and seaside resort of Lancashire, England, 46 mi. north of Liverpool. Entirely of modern growth, the resort is the Coney Island of the Lancashire industrial region, and attracts visitors from all over England. Its

amusements are highly organized and the fine beach and sea front promenade attract gay throngs. There is a Winter Garden with a glass dome 120 ft. high, and, among other massive buildings, a grand pavilion. The Town Hall is topped by a gilt vane commemorating Nelson's flagship, the *Foudroyant*, that foundered off this coast. In 1922 274 acres of undeveloped land were acquired for a well-planned park. Pop. 1921, 99,639; 1931, 101,543.

**BLACK REPUBLICAN**, a derogative term used in the southern states, particularly during the RECONSTRUCTION ERA, applying to any member of the Republican Party; an illusion of the antislavery origins of the party.

**BLACK ROCK DESERT**, an arid and dreary wasteland in northwestern Nevada, extending northeast from Pyramid Lake and covering approximately 1,000 sq. mi. in Pershing and Humboldt counties. The desert is a sink of the Quinn River. In winter it is occasionally covered with a few inches of water giving rise to the name of mud lake for the region. This water dries off in the summer leaving a hard clay surface covered with alkaline dust.

**BLACKSBURG**, a town in Montgomery Co., southwestern Virginia. It is situated 40 mi. west of Roanoke and served by the Norfolk and Western Railroad. Blacksburg is a shipping market for grain and livestock and the seat of the Virginia Polytechnic Institute, the State Agricultural and Mechanical College and a Federal and state experiment station. Blacksburg was founded in 1798 and incorporated in 1872. Pop. 1920, 1,095; 1930, 1,406.

**BLACK SEA**, or **EUXINE SEA**, an inland body of water between eastern Europe and Asia Minor. Rumania, Bulgaria, Russia and Turkey bound it on the west; Asia Minor on the south; Russia on the north; and Caucasus on the east. The Bosphorus, the Sea of Marmora and the Dardanelles connect it with the Mediterranean; the Strait of Yenikale joins it with the Sea of Azov. It is about 720 mi. long from east to west, has a minimum width of 380 mi., occupies an area of about 170,000 sq. mi., and drains a region estimated at 950,000 sq. mi. The depth of the Black Sea is amazing, exceeding 7,000 ft. in some spots. The Danube, Dneister, Don, Dneiper and Kuban are the principal European confluent; the Asiatic are the Tchoruk, Kizil Irmak, Yeshil Irmak and the Sakaria. There are sometimes fierce storms in the winter but since the sea is free of islands and rocks, navigation is not difficult. The northeastern, eastern and southwestern shores are rugged and high, but the northern and northwestern are flat. The important Russian ports situated on the shores of the Black Sea are Batum, Poti and Odessa; the Turkish, Samsun and Trebizond. The waters of the sea are almost motionless, since there is little tide; they rise and fall, however, depending upon the volume of the tributaries.

**"BLACK SHIRTS."** See FASCISM.

**BLACK SNAKE**, a popular name for a common snake (*Zamenis constrictor*) of the United States.

There are several color varieties. In the East from the Canadian border to Florida and west to the Mississippi the adults are lustrous black; further west they are bluish, and in the far West and Southwest they are green. The snake is therefore known in different regions as the black snake or black racer, the blue racer, or the green racer. It is also called the hoop snake, from the popular myth that it can take its tail in its mouth and roll about like a hoop.

Fully grown specimens are usually from 3¼ to about 5 ft. in length, and slender in form. They are good swimmers, expert climbers and extremely quick of movement upon the ground. It is said that they can leap a distance greater than their own length from tree to tree. They feed largely on mice, moles, frogs, birds, bird's eggs and smaller snakes. The idea that they track down and kill rattlers and copperheads has no foundation in fact. They are not really constrictors, and are in no way dangerous to man.

A. I. W.

**BLACKSTONE, SIR WILLIAM** (1723-80), celebrated English jurist and writer on law, was born at London, July 10, 1723. He began law practice in 1746, after obtaining his degree at Oxford, but finding himself deficient in the art of elocution he returned to Oxford to teach law. In the absence of any system of imparting to students the rudiments and philosophy of English law, Blackstone undertook to provide a course of instruction in that field. His fame is due chiefly to his lectures while at Oxford on the constitutional law of the nation. These lectures led to the establishment, by Charles Viner, a wealthy barrister, of a liberal foundation for a chair of common law at Oxford, and in 1758 Blackstone became first Vinerian professor. At the height of his success as a scholar, Blackstone resumed practice in the courts, and the reputation earned at Oxford brought him considerable business. In 1765 he published his notable work, *Commentaries on the Laws of England*, a legal compilation and discussion still in use. Three years later he entered parliament from Westbury. He declined the post of solicitor-general, becoming instead one of the justices of common pleas. Blackstone died at London Feb. 14, 1780.

**BLACKTHORN**, a name commonly given, especially in Great Britain, to the sloe (*Prunus spinosa*), a very thorny species of PLUM native to the Old World and widely planted for its ornamental flowers and fruit.

**BLACK VEIL**, the veil assumed by the nun when she finishes her novitiate. To "take the veil," therefore, means to become a nun.

**BLACK WARRIOR CASE**, 1854, a dispute between the United States and Spain over the seizure of the American vessel *Black Warrior* at Havana for the violation of the customs regulations. The entire cargo, cotton valued at \$100,000, was confiscated by the Spanish authorities. The event created considerable excitement in the United States, where a strong minority hoped for the annexation of Cuba. Soule, the American minister at Madrid, demanded in-

demnity of \$300,000 and the arrest of the offending officials; but with the presentation of evidence that no actual insult had been shown the American flag, the case was settled with the return of the cargo and vessel to the owners.

**BLACK WARRIOR RIVER**, a river of Alabama, rising from the union of Mulberry and Locust forks in the north central part of the state. It flows southward and after a course of about 360 mi. enters the Tombigbee from the east at Demopolis. Steamboats can ascend the river to Tuscaloosa above which there is considerable fall which furnishes abundant water power. Its basin, covering 19,761 sq. mi., contains extensive coal deposits.

**BLACKWATER FEVER**, a condition generally agreed to be caused by the malarial parasite, develops in persons who have had repeated attacks of malaria. For some time it was believed to be caused by quinine, the specific remedy for malaria, but it often occurs in patients who have not had sufficient quinine. Recent investigations point to three main causes: the poisons released by the parasites killed by quinine as the active agent in the destruction of the red blood cells; the lowering of the patient's resistance; the quinine itself. Due to the destruction of red blood cells, hemoglobin, the red coloring matter of the blood, appears in the urine in its decomposed form, hence the name for the disease. The symptoms come on rapidly. There is dark, often scanty, urine, with restlessness, fever, vomiting, and prostration. Treatment is unsatisfactory. It consists mainly of administration of stimulants, such as alcoholic drinks or strong coffee, and measures for the relief of the congestion of the kidneys, such as the application of heat and giving of plenty of warm water. The condition is always serious, but most patients recover. W. I. F.

**BLACKWELL, ELIZABETH** (1821-1910), the first woman to receive the degree of Doctor of Medicine in America, was born at Bristol, England, in 1821. When she was about ten years old her father came to New York. She was refused admission to Philadelphia and New York colleges of medicine, but finally entered at Geneva, N.Y., where she was graduated in 1849. Studying further in Europe and later returning to America, Elizabeth Blackwell was influential in opening up the medical career to women. She died in England in 1910.

**BLACKWELL**, a city of Kay Co., northern Oklahoma, situated about 100 mi. north of Oklahoma City. Two railroads and bus lines serve the city, and there is an airport and daily air service. The district produces chiefly grain. Blackwell is an industrial center, producing oil, zinc, brick, glass and flour. The region has extensive oil and gas fields. The city was founded in 1893. Pop. 1920, 7,174; 1930, 9,521.

**BLACKWOOD, WILLIAM** (1776-1834), Scotch publisher, born at Edinburgh, Nov. 20, 1776. He served an apprenticeship in bookselling and worked at the trade in Glasgow and London. In 1804, he opened his own shop in Edinburgh, specializing in old books. He also held the Scottish agency for cer-

tain London publishers, and, in 1817, he started a publication of his own, the *Edinburgh Monthly Magazine*, later, *Blackwood's Magazine*. This periodical surpassed all competing publications and became the organ of the Tory party. Blackwood died Sept. 16, 1834; his business being continued by his sons.

**BLADDER, URINARY**, a hollow muscular organ which acts as a reservoir for the accumulation of the urine secreted by the kidneys and carried to it from these organs by two small tubes called the ureters. The bladder empties itself at varying intervals through the urethra.

The bladder is situated in the pelvic cavity (*see* PELVIS), and in the adult male is in intimate contact with the prostate in front, which surrounds the neck of the bladder, and with the rectum posteriorly. A disease of the rectum or prostate may produce disturbances in the bladder function.

In the adult female it is in close relation with the internal female genital organs, known as the womb or uterus and the ovaries and Fallopian tubes. The uterus lies between the bladder and lower bowel or rectum. Disease of any of the female reproductive organs is likely to produce disturbances of the bladder function.

The shape of the bladder varies according to whether it is empty or full. In the empty or relaxed state it is globular and as it becomes distended it assumes a pear-shape. When completely empty it measures about 3 inches in diameter, and 4 inches longitudinally.

The nerve supply to the bladder is connected with both the central nervous system (brain and spinal cord) and with the sympathetic system. This is also important because many diseases of the spinal nerves produce disturbances of the mechanism of urination, in fact almost the first symptom of locomotor ataxia (syphilis of the spinal cord) is to be found in the act of urination (micturition).

It may not be possible to empty the bladder; it may remain distended with urine which dribbles away through the urethra as fast as it escapes from the ureters. This condition is known as incontinence of urine. Reflex emptying of the bladder, which is involuntary or during sleep, is not true incontinence. This involuntary urination of children during sleep is a reflex act, although more easily excited and less easily controlled than in adults.

Disturbances of the sympathetic nervous system, especially emotional upsets, almost always have associated irregularities in urination. These may be difficulty in control or inability to pass the urine.

The normal capacity of the adult bladder averages 250 c.c. (half pint), but there are wide variations. A normal bladder may hold as much as several quarts of urine before there is a desire to empty it.

The urine is being constantly formed; although secretion varies in its rate from time to time, it never ceases. Trickling along the tubules, the urine reaches the pelvis of the kidney, from which it is propelled along the ureters by contractions of their walls, into



the bladder. When this becomes distended, rhythmic contractions are set up in it, and notice is given of its condition by a characteristic sensation, which is perhaps aided by the squeezing of a few drops of urine past the sphincter muscle around the neck of the bladder, and into the first part of the urethra. The desire to empty the bladder can be resisted for a time. If it is yielded to, the muscular fibers in the wall of the bladder are thrown into contraction. This is aided by an expulsive effort of the abdominal muscles. The sphincter muscle is relaxed; and the urine is forced into the urethra.

The bladder is often the seat of infections, tumors, and stones. Because of the close proximity of the female bladder to the exterior, it often becomes infected. This is especially true in female infants, due to uncleanness or neglect. Contrary to what is generally said to be the case, the bladder is rarely if ever involved in gonorrhea. The symptoms pointing to the bladder are due to infection of the urethra in both sexes. Because of the proximity of the bladder to the rectum in the male, disturbances in the lower bowel, especially obstinate constipation, is one of the most frequent causes of inflammation of the bladder (cystitis). Exposure to cold and inclement weather often is the cause of bladder congestion which will in turn lower the resistance of the mucous membrane and infection will follow. This is particularly prone to occur in old men with enlarged prostate glands.

Tumors of the bladder are, more frequently than not, malignant, but in this organ more than in any other location, cancer is curable if diagnosed early. Any blood in the urine is a danger signal and calls for immediate investigation by a specialist (urologist).

Stones (calculi) of the urinary bladder are of common occurrence. Some of them are primary in the bladder itself, while some form in the kidney and then pass down the ureter into the bladder. These latter are small concretions and are commonly known as "gravel." Urinary bladder calculi must not be confused with "gall-stones." The two main causes of urinary calculi are infection and faulty physiology of digestion (metabolism). See also URINARY SYSTEM; UROLOGY: Stone. I. S. K.

**BLADDER KELP** (*Macrocystis pyrifera*), a giant brown seaweed, one of the largest marine plants known, found widely along the American Pacific coast. In southern California it forms submarine groves, miles in extent, often serving as breakwaters. The tough cable-like stems, attached to the sea bottom by great rootlike holdfasts, are sometimes several hundred feet long. They bear small leaves which are enlarged at the base into hollow bladders that keep the plant afloat. Closely related, but somewhat smaller, are the elk kelp (*Pelagophycus porra*), and the bull kelp (*Nereocystis Luetkeana*), found in the same region.

**BLADDER NUT** (*Staphylea trifolia*), a handsome shrub or small tree of the bladder nut family, found widely in moist thickets in eastern North America, and occasionally cultivated. It grows from 6 to 15

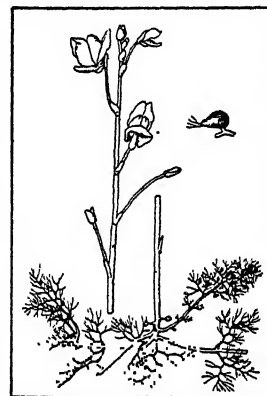
ft. high, with greenish-striped branches and opposite leaves divided in three leaflets. The small creamy-white flowers, borne in drooping clusters, are followed by conspicuous, inflated, three-horned fruit capsules. Very similar is the Sierra bladder nut (*S. Bolanderi*) of California. Several Old World species are grown as ornamentals.

**BLADDERWORT** (*Utricularia*), the name given to a numerous group of plants of the bladderwort family, comprising about 200 species found widely throughout the world, some 20 occurring in the United States. In the temperate regions, bladder-

worts are aquatic herbs inhabiting quiet waters and bearing yellow, violet or purple flowers. The common bladderwort (*U. vulgaris*), is a floating rootless plant with finely divided leaves and two-lipped yellow flowers. The leaves are provided with an immense number of tiny bladders, guarded at the mouth with strong bristles. At the flowering time the bladders fill with air, serving to keep the blossoms above the water, until fertilization takes place. Then the bladders perform another remarkable role in the economy of the plant. Minute crustaceans and other small aquatic animals often force their way into the bladders through the trapdoor-like entrances, and become permanently imprisoned. When the captured organisms die, hairlike structures lining the interior of the bladders absorb the products of their decay. The plant thus secures food direct from the animal kingdom. See also CARNIVOROUS PLANTS.

**BLADENSBURG, BATTLE OF**, Aug. 24, 1814, an engagement of the WAR OF 1812, which resulted in a British victory. To meet the invasion of the Maryland peninsula by Gen. Ross, who landed with 4,000 troops at Benedict and marched toward Washington, an improvised army of 7,000 Americans under the incompetent Gen. Winder took its position at Bladensburg, about six miles above Washington. Plans for defense were changed disastrously by Secretary of State Monroe. British rockets frightened the American militia, and after two volleys most of the volunteers abandoned the fight, fleeing toward Georgetown. Commodore Joshua Barney, whose sailors had been posted in the American line, offered the only genuine resistance. His men maintained position against great odds until Barney was severely wounded and taken prisoner. The American loss was 76; the British casualties, due mainly to Barney's command, were about 500. The defeat at Bladensburg left the national capital exposed to the British.

**BLAGOVYESHCHENSK**, a city in the Far Eastern Region of the R.S.F.S.R. It is situated on the



P. A. RYDBERG "FLORA OF PRAIRIES AND PLAINS"

AMERICAN BLADDERWORT

boundary between southeastern Siberia and Manchuria, where the Amur and the Zeya rivers join. Blagoveshchensk is an important trading center and a busy commercial port carrying on much trade in grain, gold, tea and cattle. Iron foundries and flour mills are located here. The city was founded about 1858 and has made considerable cultural advancement. It has numerous schools, theaters, libraries and museums. Pop. 1926, 61,205.

**BLAINE, JAMES GILLESPIE** (1830-93), American statesman, was born at West Brownsville, Pa. After his graduation from Washington College, Washington, Pa., he taught school at Georgetown, Ky., and later in the Pennsylvania Institute for the Blind at Philadelphia, in which city he studied law at the same time. In 1854 he moved to Augusta, Me., and adopted a journalistic career, becoming part owner and editor of the *Kennebec Journal* of that town. The first year of his editorship he stopped calling himself a Whig and gave eastern currency to the name Republican which disapproval of the Kansas-Nebraska Act had revived that year in the West as the title of a party of opposition to further slavery extension. Blaine was a delegate to the first National Convention of the Republican party, in Philadelphia (1856). For three terms beginning in 1858 he was elected to the Maine legislature, serving as Speaker of the House of Representatives for the last two. Blaine did not enlist in the Civil War but exercising his persuasive eloquence to induce men to join the army, he was most successful in obtaining recruits. Elected to the national House of Representatives in 1862 he served in that body from 1863 until 1876, being the Speaker from 1869 to 1875. Possessed of a magnetic personality, an ingratiating manner and a charming rhetorical oratory he rapidly became one of the most conspicuous Republicans in Congress.

Blaine was a firm supporter of Lincoln, he adopted an attitude towards reconstruction which left no doubt of his Unionism and yet avoided the excessive severity of the Republican extremists, assisted in the slight 1872 reduction of the tariff, and in regard to the currency problem expressed a moderate inclination towards sound money which would not antagonize sharply either inflationists or deflationists. Blaine seemed headed inevitably for the presidency until the intervention of two factors. The first was an unyielding animosity which developed between him and ROSCOE CONKLING, the powerful New York leader and chief supporter of Grant. Two hostile factions developed within the Republican party, one composed of the Grant men headed by Conkling known as the Stalwarts and the other known as the Half-Breeds of which Blaine was a principal member. The second factor intervening between Blaine and the presidency was the "Mulligan Letters" episode.

Blaine in 1876 was accused by a Democratic committee investigating railroad frauds of having used his office as Speaker in 1869 to benefit the Little Rock and Ft. Smith Railroad and later to have been indirectly rewarded by the railway company. The proof

was supposedly contained in a set of letters which came to be known as the "Mulligan Letters." Blaine obtained possession of them and in a dramatic scene personally read them with interpolations before the House. His friends considered him to be fully exonerated but his opponents were still dissatisfied, pointing out that Blaine had not permitted anyone else to see the letters. Ill health immediately before the Republican National Convention of 1876, the cloud of the Mulligan letters, and the opposition of the Stalwarts combined to prevent his selection as the presidential nominee by a slim margin. In 1876 he entered the Senate in which he remained until March 1881.

Again in 1880 Blaine was a leading candidate for the Republican nomination and was once more blocked by the unbending opposition of Conkling and the Stalwarts. He was designated as Secretary of State after the election of James A. Garfield and assumed office Mar. 5, 1881. He resigned after Garfield's death in September of the same year but at the request of the new President Chester A. Arthur, deferred his departure from office until December, when he continued to reside in Washington and began to write his *Twenty Years in Congress*. In 1884 his popularity could no longer be withstood and he was nominated by the National Convention on the first ballot. A group of independent Republicans, including Carl Schurz, who were subsequently called Mugwumps refused to support him and worked for the success of his Democratic opponent Grover Cleveland in a scurrilous campaign which was devoted largely to personal abuse of the two candidates. Blaine's narrow defeat was popularly explained by the loss of New York State by a few thousand votes as a result of Catholic resentment of Blaine's seeming acquiescence with the welcoming speech in New York City of a Rev. Samuel D. Burchard who characterized the Democrats as the party of "Rum, Romanism and Rebellion." Blaine declined to be a candidate in 1888, and being appointed Secretary of State by Benjamin Harrison he entered that office for the second time Mar. 5, 1889. He handled American foreign affairs with a resourcefulness and a vigor which infused a new spirit into the diplomacy of the United States.

In November 1881 Blaine had invited Pan-American countries to a conference at Washington, which invitation was withdrawn when he retired from office (December 1881), but was extended by an Act of Congress in 1888 and in October 1889 Blaine appropriately was the Secretary of State to greet the delegates to the Pan-American Conference at Washington. Under his influence arbitration and the facilitating of commercial relations were agreed upon and the Bureau of American Republics at Washington resulted from this meeting. Blaine negotiated several reciprocity treaties with Pan-American countries which were sanctioned by the McKinley Tariff (1890). He stoutly contended that the seals in Alaskan waters belonged to the United States on the score that the Bering was a closed sea and by treaty arrangement submitted the

dispute with England to arbitration which decided against the United States. He fearlessly asserted the rights of Americans in the Samoan Islands in a controversy with Germany and with tactful firmness settled disputes of the United States with Chile and Italy. Probably with some notion of being a candidate he resigned in 1892 a few days before the Republican National Convention. He died in Washington, Jan. 27, 1893. S. McK.

**BLAIR, FRANCIS PRESTON** (1791-1876), American journalist and political leader, was born at Abingdon, Va., Apr. 12, 1791. Educated for, and admitted to the bar, he never practiced law, but contributed to the *Argus*, of Frankfort, Ky., and became an ardent supporter of Henry Clay's presidential ambitions. Disappointed by Clay's policies during the administration of John Quincy Adams, Blair joined the Jackson forces, and in 1830 was summoned to Washington, where he established the *Globe*, an administration journal. Under his editorship the *Globe* denounced the Bank of the United States, Clay's "American System" and the nullification theory of South Carolina. It became the recognized Democratic organ and its editor a power in the party. Though Blair was an ardent supporter of Jackson and Van Buren, he felt that the Democratic Party was coming under the influence of its southern wing, and in 1856 he helped to form the Republican Party. In 1860 he worked for the nomination and election of Lincoln, and supported his policies as President. He made an unofficial visit to Jefferson Davis in 1864, and the unsuccessful Hampton Roads Conference, Feb. 3, 1865, was called through his efforts. Some time after Lincoln's death the reconstruction policies of the radical Republicans drove him back into the Democratic Party. He died at Silver Spring, Md., Oct. 18, 1876.

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**BLAIR, MONTGOMERY** (1813-83), American statesman, was born in Franklin Co., Ky., on May 10, 1813. He was educated at West Point, graduating in 1835. He served in the Seminole War, but resigned his commission in 1836 to study law at Transylvania University. Admitted to the bar in 1839, he was appointed Federal district attorney in Missouri but was removed by President Tyler. He was mayor of St. Louis in 1842-43, and was judge of the Court of Common Pleas from 1845-49. Moving to Maryland in 1853, he practiced law before the United States Supreme Court, and in 1855 became the first solicitor for the federal Court of Claims. Dissatisfied with the attitude of the Democratic party toward slavery, he supported the Republican ticket in 1860. In 1860 he was made Postmaster-General under Lincoln, but was asked to resign in 1864. He was elected to the Maryland house of delegates in 1878, and ran unsuccessfully in 1882 for Congress. He died at Silver Spring, Md., on July 27, 1883.

**BLAIR, ROBERT** (1699-1746), Scottish poet, was born at Edinburgh, in 1699. He studied at Edinburgh

University and in Holland, and, in 1731, became clergyman at Athelstaneford, East Lothian. His poem, *The Grave*, published in 1743, ranks as a minor classic in English literature. Blair died at Athelstaneford, Feb. 4, 1746.

**BLAIRSVILLE**, a borough of Indiana Co., in southwestern Pennsylvania, situated on the Conemaugh River, 43 mi. east of Pittsburgh. It is served by the Pennsylvania Railroad. There are coal mines in the neighborhood. The borough has plate glass, enamel-ware and silk factories, and iron and steel mills. It is the seat of the Western State Hospital for the Insane. Blairsville was founded in 1818 and incorporated in 1825. Pop. 1920, 4,391; 1930, 5,296.

**BLAKE, EDWARD** (1833-1912), Canadian lawyer and Liberal statesman, was born in the township of Adelaide, Upper Canada. Educated at Upper Canada College and the University of Toronto, he rapidly rose to prominence as a lawyer before entering politics. In 1867 he was elected both to the Legislative Assembly of Ontario and to the House of Commons of Canada. In 1869 he became leader of the Liberal party in Ontario and two years later prime minister of that province. From this office he resigned in 1872 on the abolition of the right to sit both in provincial and federal parliaments. Under ALEXANDER MACKENZIE he was minister without portfolio in 1873 and minister of justice in 1875-77, and in 1879-87 he led the Liberal party in the federal arena. He was succeeded by Wilfrid Laurier in 1887 and in 1890 retired from Canadian politics. Moving to England, he sat as an Irish Nationalist member at Westminster from 1892 to 1907, but made no mark there. Though continued ill-health, or other causes, robbed him of the highest prizes, Blake was a man of great importance in Canadian life. After Confederation he became a leading constitutional lawyer, and pled cases before the Judicial Committee of the Privy Council; the Supreme Court of Canada was organized during his term as minister of justice; and he was a prominent advocate of provincial rights within Canada and of Dominion autonomy within the Empire. T. P. P.

**BLAKE, ROBERT** (1599-1657), English admiral, was born at Bridgewater, Somerset, in Aug. 1599, and was educated at Oxford in 1615-25. He entered the army, and was a conspicuous figure in several engagements. In 1649 he was appointed a "general of the sea." He first practically destroyed Prince Rupert's squadron. Then, in the service of Cromwell's republican government, he forced the Royalists to surrender at Guernsey, Jersey and the Scilly Islands, and in 1652 became sole admiral of the British fleet. In his first conflict with the Dutch he defeated them, making England supreme on the sea. In 1654 he was sent by Cromwell to command the English fleet in the Mediterranean. In that sphere he went to Algiers and Tripoli and set free all imprisoned Englishmen. Later he made alliances with Venice and Tuscany that were advantageous to England. His last spectacular feat was accomplished in 1657 when he de-

stroyed the Spanish Plate Fleet in an encounter at Tenerife. He died at Plymouth Harbor on Aug. 7, 1657.

**BLAKE, WILLIAM** (1757-1827), English poet and artist, was born in London, Nov. 28, 1757, the son of a well-to-do hosier. He began studying drawing at the age of 10 and at 12 wrote his first poem. After being apprenticed to an engraver, he studied at the Royal Academy, but soon decided that the creatures of his imagination were more real to him than actual models. He supported himself by engraving for publishers, while he wrote, designed, and with some technical help from his wife, engraved and colored by hand his *Songs of Innocence*, 1789; and, between 1789-1804, his *Book of Thel*, *Marriage of Heaven and Hell*, *Visions of the Daughters of Albion*, *America*, *A Prophecy*, *The Book of Virgil*, *Jerusalem* and *Milton*. Among his other works are his designs for *Blair's Grave*, and for *The Book of Job* and his poetry, *Songs of Experience*. As a painter, watercolorist and engraver Blake produced some of the most strangely beautiful works of art ever created by a mystic out of his visions. As a poet he wrote early in his career the fresh and charming lyrics of *Songs of Innocence*; thereafter, losing the lyric spirit, his poetry became almost exclusively an expression of his consuming mysticism, filled with prophecies and blazing visions. Blake died in London, Aug. 12, 1827.

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**BLAKELOCK, RALPH ALBERT** (1847-1919), American painter, was born in New York City, Oct. 15, 1847. He studied medicine but gave it up to become a painter. His only art instruction was had in a few classes at Cooper Union, New York, but he opened a studio and began to paint, using the works of his favorite artists to guide him. Blakelock practiced to attain subtle and moving color effects which distinguish his evening and moonlight scenes and his studies of American Indians. For many years his pictures attracted no attention and he endured severe hardships and privations which unsettled his mind just as his works were beginning to be noticed. After 18 years in an insane asylum he was released in 1916 and resumed painting but produced nothing remarkable. Meanwhile his early canvases were being collected. As an American landscape painter he was ranked with Inness, Wyant and Homer. The Toledo Museum paid \$20,000 for his *Brook by Moonlight* for which he originally received \$500. Some of his best pictures are *Autumn*, *Sunset*, *Nevarra Range*, *Indian Girl*. *The Pipe Dance* and *Indian Encampment* are in the Metropolitan Museum, New York. Blakelock died at a camp in the Adirondacks, Aug. 9, 1919.

**BLAKELY**, a borough in Lackawanna Co., in northeastern Pennsylvania, situated 7 mi. northeast of Scranton and served by three railroads. Coal-mining is the chief industry of this region, and there are

three silk mills in the borough. Pop. 1920, 6,564; 1930, 8,260.

**BLANC, JEAN JOSEPH LOUIS** (1811-82), French historian and labor leader, was born at Madrid, Oct. 29, 1811. He studied law at Paris; he became an ardent Socialist and in 1839 founded the *Revue du Progrès* in which he published in 1840 *The Organization of Labor*, his chief work on Socialism. Between 1847 and 1862 he wrote a detailed account of the French Revolution. When the February revolution broke out in France in 1848, he was a member of the provisional government and later of the National Assembly. He was also made president of the Labor Commission and an attempt was made to establish national workshops but his plan for the organization of labor was never given a fair trial. After the fall of the empire in 1871 he was elected to the Chamber of Deputies. He died at Cannes, Dec. 6, 1882.

**BLANC, MONT**, loftiest Alpine summit, 15,780 ft. high, the peak of which is in French territory, 40 mi. south of Lake Geneva. On its south side is the pass of Little St. Bernard. The ridge of which it forms a part lies in French, Swiss and Italian territory. Geologically it is composed in large part of crystalline rock. Its peak is perpetually covered with ice over 70 ft. thick, from which huge glaciers extend in all directions; in the north is the Mer de Glace, famous throughout the world. Others are Bossons and Tacconnaz in the north and Brenva and Miage in the south; these feed the tributaries of the Rhone and the Po rivers. The line of perpetual snow is between 8,000 and 9,000 ft. Mont Blanc's craggy summit is difficult of ascent, the first successful attempt being made in 1786. The lofty majesty of the peak attracts thousands of tourists each year, a number of whom make the ascent during the summer months, usually from Chamonix, France. Two observatories on the mountain top have gone into disuse. See ALPS.

**BLANCO-FOMBONA, RUFINO** (1874- ), South American writer, was born at Caracas, Venezuela, June 17, 1874, but was for many years an expatriate, living chiefly in Spain and France. He is one of the outstanding figures, public and literary, of Spanish America, and in recent years, as head of the Editorial América, a publishing house established in Madrid, has done much to disseminate the more important works of the Spanish-American classics and the advanced moderns. Blanco-Fombona is primarily the man of action, and into his multifarious writings has swept much of the gusto, the fearlessness, the candor and the swashbuckling honesty that have characterized his nomadic, dramatic career.

In his youth Blanco-Fombona saw consular service in Philadelphia. He engaged in ardent political struggles and was sent to prison for his impetuous libertarianism. He traveled through the wilds of South America and, for a time, ruled there for his country. The culture of Spain, France, Holland and Russia were familiar to him through various diplomatic mis-

sions. Out of this restless life were borne verse, fiction, literary criticism and miscellaneous writings, numbering some 34 volumes. Not least among his labors is the service he has done to the inspiring memory of SIMÓN BOLÍVAR, in editions of Bolívar's letters, in his modernization of the *Life* by Felipe Larrazabal, and in his own 2-volume work on the Liberator. Among the more significant volumes of verse are *Trovadores y trovas* and *Pequeña ópera lírica*; of the novels, *El hombre de oro* has been translated into English as *The Man of Gold* and has appeared also in Italian and Dutch. Other novels, always founded upon life in the disrupted Venezuela of contemporary days, are *El hombre de hierro*, *La máscara heróica*, *La mitra en la mano* and *La bella y la fiera*. *El conquistador español del siglo XVI* is a penetrating study of the psychology of the conquerors and of the conquered; it is companioned, for politics, by *La evolución política y social de Hispano-América*.

Blanco-Fombona's critical evaluations partake of his outspoken, polemical nature, but they are nevertheless important to the history of the modernist movement in Spanish America; chief among them are *Letras y letrados de Hispano-América*, and *El modernismo y los poetas modernistas*. He is the ardent advocate of that Magna Patria that was visioned by Bolívar; repudiating "isms," he heralds a sort of aristodemocracy that reconciles Karl Marx with Nietzsche. In literature, also, Blanco-Fombona demands for Spanish America a like independence, acknowledging her debt to Europe as modern Europe acknowledges her debt to the ancients, but pointing out that such indebtedness should not stand in the way of cultural individuality.

I. G.

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**BLAND-ALLISON ACT**, a bill, passed Feb. 28, 1878 over the veto of President Hayes, restoring the full legal-tender character of the silver dollar and authorizing the purchase and coinage by the Treasury of silver at the market price, in an amount from \$2,000,000 to \$4,000,000 monthly. The price of silver had been unsettled since 1871. Financial depression had continued since the panic of 1873, strengthening the demand for an inflated currency. To revoke the demonetization of silver (*see* CRIME OF 1873) was a prominent scheme of inflation. A bill presented by Richard P. Bland of Missouri for the free coinage of silver passed the House in 1877. In the Senate conservative influences, headed by William B. Allison, secured the final modification. The operation of the Bland-Allison Act was superseded in 1890 by the SHERMAN SILVER PURCHASE ACT.

**BLANK VERSE**, an unrhymed, iambic decasyllabic verse, the usual vehicle of English dramatic and epic poetry. SHAKESPEARE and MILTON were the great masters of this medium. Two books of the *Æneid*, translated into English blank verse by Henry Howard, Earl of Surrey, in the 16th century, began its vogue in England. *Gorbuduc*, by Sackville and Norton, 1565, is the first English drama in blank verse, and MAR-

LOWE established it as the meter of tragedy. *See also* POETRY; ENGLISH LITERATURE.

**BLANQUI, LOUIS AUGUSTE** (1805-81), French revolutionist, was born at Puget-Theniers, Feb. 7, 1805. While studying law and medicine in Paris, he joined the revolutionary movement and became a prominent leader of the proletariat. He was imprisoned for life for helping instigate the insurrection of May 12, 1839. Set free by the Revolution of Feb. 1848, he was imprisoned the following year for 10 years for inciting rebellion. Liberated in 1859, he was again imprisoned for four years in 1861 as an instigator of riot. In 1871 he participated in the insurrection which finally established the Paris Commune, and then became an official under the Communal administration. With the overthrow of this government, he was again sentenced to prison, but pardoned in 1879. He died on Jan. 1, 1881. *See* FRANCE: History.

**BLANTYRE**, a parish of Lanarkshire, Scotland, about 14 mi. southeast of Glasgow, on the Clyde. It includes High Blantyre and Blantyre Works where, in 1813, David Livingstone, African explorer and missionary, was born. On the river bank there is a ruined 13th century priory connected by a subterranean passage with Bothwell Castle across the Clyde which is also in ruins. The once important cotton mills of the region gradually declining, the population now is largely employed in the regional coal-mines. Pop. 1921, 18,154; 1931, 17,015.

**BLASCO IBANEZ**. *See* IBANEZ, VINCENTE BLASCO.

**BLASHFIELD, EDWIN HOWLAND** (1848- ), American artist, was born in New York City, Dec. 15, 1848. He studied painting at Paris under Bonnat and exhibited in the Paris Salons. Returning to the United States in 1881, he produced a number of portraits and pictures, including *Christmas Bells* and *The Angel with the Flaming Sword*, but made his greatest success in his mural decorations, which are noted for their composition and coloring. He decorated the dome of the Library of Congress and did work on the Capitol buildings of Iowa, Minnesota, South Dakota and Wisconsin. He wrote *Mural Painting in America*, published 1913, and was a co-editor of Vasari's *Lives of the Painters*.

**BLASIUS** or **BLAISE, ST.**, bishop and martyr, was born in the 4th century, probably in Asia Minor. The tradition is that he was abbot of Sebaste in Asia Minor and that he was martyred during the persecutions under Diocletian. Owing to his miraculous cure of a boy who had a fishbone lodged in his throat he is invoked against throat troubles. The date of his martyrdom is generally given as Feb. 3, 316.

**BLASPHEMY**, an expression of impious language concerning the Almighty, which is revolting to orthodox believers. It may also be doubting the divinity of Christ, the chastity of Mary, or even language which casts disgrace upon the Bible, according to the laws of various countries and states. Lord Mansfield held that "The true principles of natural religion are part of the COMMON LAW: the essential principles of re-



vealed religion are part of the common law: so that a person vilifying, subverting or ridiculing them may be prosecuted at common law."

**BLAST FURNACE.** See IRON BLAST FURNACE.

**BLAST HEATING**, a heating system utilizing a heater, a fan or blower, and a system of air ducts. The heater may be constructed of cast-iron sections, steel, wrought iron, copper or brass tubes, or of extended-surface sections, and may be heated by steam, hot water or hot gas. The fan may be arranged to either draw or blow the air over the heater. The fan and heater are usually placed outside of the space to be heated. The system is well adapted to large buildings. The system provides means for ventilation, as new air may be drawn in by the fan, and filtered, washed or humidified as required. See also AIR CONDITIONING.

In spaces where new air is not required for ventilation, all or part of the air may be re-circulated, leading to considerable economy. The temperature of the delivered air is not limited, but lower temperatures and larger volumes of air will give better temperature distribution throughout the space to be heated. In buildings where some noise is not objectionable, air velocities throughout the system may run up to more than 2,000 feet per minute. In such places as churches, auditoriums and theaters, high velocities will produce an objectionable noise, and velocities in branch ducts must often be kept as low as 300 to 600 feet per minute. F. B. R.

**BLASTING**, in mining and quarrying, the use of explosives for breaking rock. One or more cartridges of dynamite, or other PERMISSIBLE EXPLOSIVE, are inserted into the bottom of a hole drilled into the rock. A detonator, or blasting cap, with a FUSE attached, is inserted into one cartridge which serves as a primer. After the primer has been put into place, with the fuse extending beyond the mouth of the hole, the hole is filled with clay or fine sand and tamped to the collar. Then the fuse is ignited. Fuses are frequently cut in different lengths so as to set off the blasts in a desired succession, thereby increasing their effectiveness. Electric blasting machines are much in use, especially in shaft sinking; an electric current ignites the detonator. See also STEMMING.

**BLAVATSKY, HELENA** (1831-91), founder of modern Theosophy, was born at Ekaterinoslav, south Russia, July 30, 1831. As a child she was subject to hallucinations. After travels throughout Europe and in India and Egypt, she settled in New York City and practised Spiritualism until she became interested in Egyptian occultism, on the principles of which the Theosophy Society was established in 1875. In 1876 she published *Isis Unveiled*. In succeeding years many attempts were made to expose her as a charlatan. Nevertheless she had built up a group of nearly 100,000 followers of theosophy at the time of her death in London, May 8, 1891.

**BLAZING STAR**, the name applied in the United States to various native plants with showy flowers. East of the Great Plains the button snake-

root (*Liatris scariosa*), and the colic-root (*L. squarrosa*), of the composite family, with handsome purple flowering spikes, are called blazing star. The devil's-bit (*Chamælirium luteum*), of the lily family, with



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**BLAZING STAR**

(*Mentzelia laevicaulis*). Cross section of ovary (upper left), stamens, flowering branchlet and leaf

feathery spikes of white, fragrant flowers, found in the same region, likewise bears the name. In the western states, a showy white-stemmed perennial (*Mentzelia laevicaulis*) of the loasa family, with glossy yellow, star-shaped, flowers, 3 or 4 in. across, is known as blazing star.

**BLEACHING**, a process of treating textiles in such a manner as to make them white. In a broad sense, the term includes washing, scouring, degumming, and bleaching proper, and refers to the various treatments involved in removing waxes, fats, gums, coloring matter, and other impurities. COTTON, WOOL, and SILK may be bleached in the form of raw stock or at any stage of manufacture from yarn to finished fabric. Most of the other natural fibers and all of the synthetic fibers are bleached in the form of yarn or woven or knitted fabrics.

Operations in bleaching cotton include: (1) Boiling-out with dilute solutions of caustic soda, soda ash, lime, or other alkalis, to which may be added soap, sulphonated oils, organic solvents, and other detergents or emulsifying agents; (2) chemical action, as destruction of coloring matter by means of sodium or calcium hypochlorite; and (3) washing, neutralizing with SULPHURIC or HYDROCHLORIC acid, called souring (or with sodium bisulphide or sulphurous acid, called anti-chloring), and again washing. Hydrogen peroxide often is used in place of sodium hypochlorite, and other bleaching agents occasionally are employed. Woven fabrics before boiling-out are usually singed over a gas flame or heated roller to remove the loose

fibers projecting from the surface, and are sometimes steeped in warm water or treated with diastatic compounds to render soluble the starch and dextrin used in preparing the warp for WEAVING.

Wool is scoured before bleaching by treatment with soap, sodium carbonate, or a mixture of the two. Organic solvents are also used to some extent in wool scouring in place of alkaline detergents. Bleaching of wool is accomplished by means of sulphurous acid in the gaseous form as sulphur dioxide or as a solution of sodium bisulphite in water. Hydrogen peroxide is now used extensively for bleaching wool. Perborates, potassium permanganate, and other bleaching agents are occasionally employed. Wool and other animal fibers are not bleached with the hypochlorites.

The two major operations in silk bleaching are boiling-off or degumming and bleaching proper. The degumming process consists essentially of treating the silk with hot fairly concentrated solutions of soap or with so-called boil-off oil solutions. Bleaching is accomplished by treatment with hydrogen peroxide, or less often with perborates, sulphurous acid, potassium permanganate, or other bleaching agents.

Rayon and other synthetic fibers are bleached in a similar manner as is cotton. The methods used in bleaching linen, hemp, ramie and other vegetable fibers differ only in detail. Animal fibers other than wool and silk are bleached in much the same way as outlined for wool and silk.

Equipment used in bleaching varies in design according to the type of fiber, the stage of manufacture at which the textile is processed, and the method and chemicals employed. W. W. C.

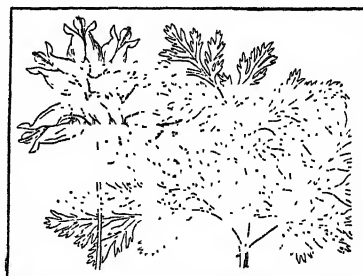
**BLEACHING POWDER.** See CHLORINATED LIME.

**BLEAK HOUSE**, a novel by CHARLES DICKENS, revealing the useless tragedies and waste which attend the red tape of legal procedure. In the plot of this long novel, which was published in 1853, all the characters are in some way connected with the interminable case of *Jarndyce vs. Jarndyce*. In the order of their importance, the characters include Lady Deadlock, who dies tragically to keep a secret; Esther Summerson, the unacknowledged illegitimate daughter of Lady Deadlock; kindly John Jarndyce, owner of Bleak House; Richard Carstone and Ada Clare, two young wards of Jarndyce; Tulkinghorn, lawyer to the Deadlocks, murdered by Lady Deadlock's French maid; the rascally Smallweeds; irresponsible, artistic Mr. Skimpole; boisterous Mr. Boythorne; and Krooks, one of the few characters in fiction who die of spontaneous combustion.

**BLEEDING.** See HEMORRHAGE.

**BLEEDING HEART** (*Dicentra spectabilis*), a hardy perennial of the fumitory family, native to Japan and widely cultivated for its attractive flowers and foliage. The stems, about 2 ft. high, bear much-divided leaves and long clusters of pendent, rose-red flowers, which are heart-shaped with the inner white petals protruding. When given sufficient room and moisture, bleeding heart will serve as a handsome

foliage plant long after the flowers have disappeared. The western bleeding heart (*D. formosa*), a handsome species with rose-purple flowers, grows in moist woods from central California to British Columbia.



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WESTERN BLEEDING HEART  
Flowering spike and blade of leaf

**BLLENDE.** See SPHALERITE.

**BLLENHEIM, BATTLE OF**, Aug. 13, 1704, an engagement of the WAR OF THE SPANISH SUCCESSION, fought near the Bavarian village of Blenheim, in which the English and Austrian forces under Prince Eugene and the Duke of Marlborough defeated the French and Bavarians under Marshals Tallard and Marsin. The field was hotly contested. French military supremacy began to decline after this battle.

**BLENNERHASSET, HARMAN** (1765-1831), English financier, was born in Hampshire, England, Oct. 8, 1765. Inheriting considerable property, he emigrated to America in 1797 and bought the island on the Ohio, later known by his name. In 1805 he was involved by AARON BURR in the ambitious political schemes which two years later brought both men to ruin. He was twice arrested for complicity in these schemes, but was freed on Burr's acquittal. With most of his property gone, he engaged in a number of unsuccessful business ventures in Mississippi and Montreal, then returned to Ireland. He died at Guernsey, Feb. 2, 1831.

**BLEPHARITIS**, in inflammation of the margin of the eyelids. This disease manifests itself by a redness of that part of the eyelid that extends between the roots of the eyelashes and the sharp margin of the eyelid that lies in contact with the eyeball. As a rule, it is accompanied by the formation of dried crusts in the roots of the eyelashes, which in severe cases (blepharitis ulcerosa) may conceal actual ulceration of the skin. In nearly all cases, blepharitis is accompanied by an inflammation of the lining membrane of the eyelids, to which the skin condition may be only secondary. The disease is apt to be resistant and may necessitate long continued treatment. See also LIGHT, ARTIFICIAL, IN TREATMENT OF DISEASE. H. S. G.

**BLEPHAROSPASM**, a more or less involuntary tight closure of the eyelids by a severe contraction of the orbicularis muscle. Blepharospasm may be a pure nervous manifestation, due to excessive stimulation of the circular muscle that closes the eyelids by its contraction. But in the majority of cases, blepharospasm is a protective reaction of an involuntary contracture

of the eyelids. If the cornea is roughened or if there be a foreign body lodged there, movement of the eyelids over the eyeball is painful, as a result of which the orbicularis muscle goes into a state of cramp to prevent further painful motion. Blepharospasm due to inflammatory conditions of the eye disappears spontaneously on relief from the disease, whereas the nervous type is more resistant.

H. S. G.

**BLESSED DAMOZEL, THE**, a highly imaginative poem by the pre-Raphaelite poet and painter, DANTE GABRIEL ROSSETTI; published 1851. This poem, rich in its use of images and symbols, is the lament of a young girl in Heaven who looks down upon earth with yearning for her lover.

**BLESSED SACRAMENT**, one of the titles of the sacrament of the EUCHARIST, which designates its supremacy over the others. It is common to nearly all Christian churches, but differs greatly among them as to form and interpretation. According to the synoptic Gospels (Matthew 26:26; Mark 14:22; Luke 22:19 and I Corinthians 10:16 and 11, 23 ff.), it was instituted by Jesus Christ on the night on which he was betrayed, with the command that it be continued as a perpetual memory of his death and sacrifice until his coming again. The symbolism of the act reveals the rich and deep relationship to religious significance of that death, while corresponding to the ritual custom of the Jewish feast of the PASSOVER. Thus it inaugurates a new covenant in the relationship of the faithful to God and Christian fellowship among men. Abuses such as mentioned by St. Paul (I Corinthians 2:21-22) caused the Lord's Supper to be held as part of the Sunday morning service, removing it from Jewish associations. Later it became esoteric, all but the baptized being excluded from the most solemn part of the service. Increasing emphasis was placed upon the sacrifice of Our Lord, as the bishop, in a prayer of thanksgiving, *eucharistia*, consecrated the oblations of bread and wine offered by the faithful. At least as early as the 3rd century, the Lord's Supper was called the eucharistic sacrifice, that is, the actual body of Christ as present in the sacrament. This conception of Christ's sacrifice, "by his one oblation of himself once offered," is expressed in the sacrifice of the MASS. The acrimonious and disuniting strife in medieval times and later as to the nature of the sacrament, transubstantiation, real presence, sacrifice or memorial rite, though still nominally maintained by protagonists of various confessions, seems to belong to the past; partly, no doubt, from indifference and partly from a more spiritual conception of the Blessed Sacrament as an outward and visible sign of an inward consciousness of the inherent spiritual unity of God and man, and of the Church as the blessed company of all faithful people.

**BLICHER, STEEN STEENSEN** (1782-1848), Danish poet and novelist, was born at Vium, in Jutland, Oct. 11, 1782. He was educated at the University of Copenhagen and became a clergyman. Many of his stories and poems were written in the dialect of Jutland. His works include *Romances of*

*Jutland, National Novels*, and several treatises on hunting and agricultural economics, besides collections of poems. He died at Spenstrup, Mar. 26, 1848.

#### BLIND, CARE AND EDUCATION OF THE.

The earliest efforts to care for the blind as a special class distinguished from other needy people took the form of custodial institutions; such as, a hospice at Caesarea in Cappadocia established by St. Basil in the fourth century; and the *Quinze-Vingts*, established in the thirteenth century, whose founding was traditionally ascribed to St. Louis. Not until Valentin Haüy, in 1784, discovered a method of teaching the blind to read from raised letters embossed on paper, did any real ray of hope penetrate the world of the blind. Then schools for the blind were rapidly established. Most of the European schools early took on the character of trade training establishments, and later employment institutions. The most famous schools for the blind in Europe are: *Institution Nationale des Jeunes Aveugles* in Paris, especially notable for its training of musicians; *Blindenerziehungs-Institut* in Vienna, famous for its reference library, and museum; and the *Royal Normal College and Academy of Music for the Blind* in London, notable for its success in training blind people for semi-professional pursuits, such as piano tuning, music teaching, stenography, etc.

Gradually the number of agencies for the education, employment, and relief of the adult blind multiplied, especially throughout Western Europe, until to-day there are few districts in this section of Europe and the British Isles which have not made considerable provision for this part of the population. Home instruction of adults has been carried into its highest form in Great Britain, where in many districts there is an average of one home teacher for each 125 of the blind population. A large proportion of the strictly employment institutions, however, conduct day workshops, where employees have the option of living in their own homes or in a boarding house conducted by the institution.

The most comprehensive program for the care of the blind in Europe is to be found in Great Britain, where most activities, both public and private, are subsidized and supervised by the central Government. In Great Britain is to be found a very complete system of outdoor relief for the blind, which is commonly referred to as a pension.

During the past decade Germany has attracted world-wide attention by its law which provides that the larger industrial concerns shall employ a certain percentage of disabled persons, including the blind.

The three oldest schools for the blind in the United States—the *New York Institute for the Education of the Blind*, the *Pennsylvania Institution for the Instruction of the Blind*, and *Perkins Institution and Massachusetts School for the Blind*—were organized at about the same time, 1832. These institutions are under private management, but the states furnish a large share of their support. The first state school for the blind was established by Ohio in 1837. To-

day every state either conducts a residential school of its own, or has a working arrangement by which it pays for the tuition of its blind children in a similar school in a neighboring state. The children attending public school classes live in their own homes and go to school each day as do seeing children. While there is a special teacher and classroom for each eight or ten children, the blind pupils do much of their reciting in the regular classes. The first public school class for the blind was organized by the city of Chicago in 1900. Since that time 14 cities have followed Chicago's lead.

Schools for the blind receive not only children who are absolutely without sight, but also those who by reason of defective vision cannot make use of ink-print books. Children with more than one tenth normal vision, except under special circumstances, are not usually received in schools for the blind. There are, however, many pupils with vision ranging from one tenth to one third normal sight greatly outnumbering those eligible for admission to schools for the blind. This visual defect prevents them from making full use of the ordinary public school opportunities. In 1913 the cities of Boston and Cleveland opened special classes for this group of pupils. These are known as "sight-saving" or "conservation of vision" classes. The movement thus started has had a rapid growth until, in 1931, 106 cities have made provision for such pupils. The school rooms have unusually good natural and artificial lighting conditions, and the books printed especially for such work are in a large, heavy ink type. These books are published by the Clear Type Publishing Committee of Montclair, New Jersey.

Special institutions of higher learning for the blind have never found much favor, though at Marburg, Germany, there is a college for the blind affiliated with Marburg University. Many blind men and women, however, attend the regular colleges and universities. In 1907, New York State first established scholarships to employ "readers" for blind students attending institutions of higher learning in that state. At present 21 states have similar scholarships.

Schools for blind children in the United States had not been long in operation, before it became evident that the academic and vocational training afforded children in such schools did not solve the employment problem of the blind. Accordingly, several employment institutions were opened, receiving more or less state support. But as the activities of these employment institutions were quite restricted, state commissions or departments came to be organized to care for the general needs of the blind, especially adults. Twenty-nine states now have such agencies. The activities of state commissions for the blind differ somewhat, but in general they consist of the following: home teaching; provision for vocational training, and employment; vocational placement; prevention of blindness. In several large cities private associations for the blind have been organized to carry on such activities.

Blindness is so definite a cause of poverty that special provision of public relief for the needy blind has long been demanded. In 1903 Illinois inaugurated special county relief for the blind, popularly known as a "pension." At the end of 1930 there were 23 states having such special relief laws.

The employment field for the blind is narrowed not only by the limitations imposed by blindness, but also by the lack of confidence on the part of the seeing public in the productive powers of the blind. Employed blind people may be divided into four classes: first, those who have set up for themselves in business or in professions; second, those who are employed side by side with the seeing in factories and commercial establishments; third, those employed in sheltered workshops; and fourth, those working in their own homes under the supervision of a central agency for the blind.

Until the beginning of the present century the blind man who had found work as an ordinary factory hand was rare indeed. About 25 years ago, however, Charles F. F. Campbell, an enthusiastic worker for the blind in Massachusetts, began a movement for the employment of blind people in industry, but it did not become widespread until the years of the World War.

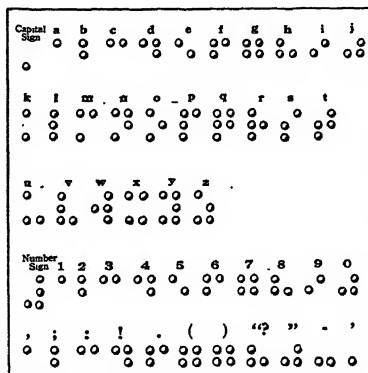
However, owing to the rapid development of labor-saving machinery and to various other reasons, the number of blind people now working in factories is very small.

In most large cities may be found one or two small sheltered workshops employing a dozen or more men. These shops usually operate at a loss, and the deficit is made up through either private philanthropy or taxation. The commonest activities carried on are chair caning and the manufacture of brooms, mops, rugs, and reed ware.

Many state commissions and city associations arrange to sell the products made by the blind in their homes. Articles so manufactured include dish towels, aprons, rugs, baskets, crocheted and knitted ware, and stuffed toys.

Although Valentin Haüy demonstrated that some blind people could read the embossed Roman letters, a large proportion of the sightless population were unable to make any considerable use of this system. During the century following Haüy's announcement, scores of tangible alphabets were devised, and books were printed in them. Many of these bore some resemblance to the Roman alphabet; others were phonetic shorthand systems; and still others were alphabetic codes made by the arrangement of dots in arbitrary forms. Of these types, the use of only two has survived to the present day—one, the Moon system, a series of raised lines slightly resembling the Roman alphabet, especially well-adapted to the use of those blinded in later life; and the other, a system of dots invented in 1829 by Louis Braille, a blind teacher in the *Institution Nationale des Jeunes Aveugles* in Paris. Braille's system is now practically universal throughout the civilized world, though, in addition to his

alphabet, a set of contractions designed to reduce the bulk of embossed books has been developed for each language. The Braille code used in the United States is similar to that employed in Great Britain except



COURTESY AMER. FOUNDATION FOR THE BLIND, INC.

#### BRaille ALPHABET AND NUMERALS

Each of these circles represents in natural size the raised points in the paper which make it possible for the blind to read with their fingers. Letters are made capitals by prefixing the capital sign. The first ten letters, preceded by the number sign, represent numbers

that the British use a large number of contractions. A method of reproducing in embossed letters, on aluminum foil, reading matter of any language is now being perfected by means of an instrument called the VISAGRAPH.

School books for the blind are largely supplied by the Federal Government, operating through the American Printing House for the Blind at Louisville, Kentucky. In 1931 Congress enacted the Pratt-Smoot law, authorizing the appropriation of \$100,000 annually to the Library of Congress with which to carry on the publication and circulation of books for the adult blind. The Post Office cooperates in the circulation of library books for the blind by transmitting such books through the mails free of charge. In 1907 Mrs. Matilda Ziegler of New York City established the *Matilda Ziegler Magazine for the Blind*, a monthly periodical which is sent free to any sightless person in the United States or Canada. A number of other secular and religious magazines have since been started. The Lions International has adopted work for the blind as one of its major activities. It publishes a magazine in Braille for blind children, and has helped to inaugurate work for the adult blind in several states.

*The American Foundation for the Blind* is a national organization in New York City, (1) promoting state and Federal legislation in behalf of those without sight, (2) arranging for the establishment of the native agencies for the blind throughout the country, (3) collecting and disseminating information regarding all phases of work for the blind. R. B. I.

**BLINDFISH**, any of several fishes having degenerate eyes. The best known family (*Amblyopsidae*) are found mainly in caves, while others live in deep

springs and open streams. A blind Goby lies embedded in sand under rocks along the California coast. Blindfish are also found at great depths in the ocean. In the Mammoth Cave of Kentucky lives a slender, five-inch translucent fish (*Amblyopsis spelae*) with no external indication of eyes in the normal adult form. It is possible to trace the optic nerve in young fish under 1 in., and even at 2 in. rudimentary eyes are visible; later they are covered by tissue. Tactile papillae, serving as delicate touch organs, are on the head and body and aid the blindfish, whose movements are uncertain, in determining its course. The sense of touch is far more highly developed than the sense of sound. The blindfish feeds on invisible water animals, some blind, and small crustaceans. In the breeding period from spring to fall, the female gives birth to live young. Another blindfish (*Typhlichthys subterraneus*) lacking ventral fins, is found in caves of Indiana, Kentucky, and Tennessee. It has the colorless body common to all cave animals.

**BLIND FLYING**, flight in which no natural references such as the horizon, sky or ground, are visible to the pilot, instruments only being used to determine altitude and to keep a definite "heading." The pilot's so-called sense of equilibrium is inadequate for determining straight and level flight, due to a confusion of impulses. For example, variations in the rate of turning produce false reactions, known as vertigo (*see MENIERE'S DISEASE*), whereby the pilot may even get the conception that he is turning opposite to the actual direction of turn. To successfully fly by instruments requires considerable training, as a pilot tends to respond instinctively to the impulses received through his senses and to disregard the indications of instruments. Also, the indications of instruments require interpretation before the pilot can create a mental image of the position of his airplane.

AIRCRAFT INSTRUMENTS measuring or indicating motion or change of attitude about 3 axes, either directly or indirectly, are used in blind flying. A. F. HE.

**BLINDNESS, MEDICAL ASPECTS OF.** Blindness is the greatest special-sense catastrophe that can happen to man. At present, about 100,000 of the people of the United States have such serious loss of vision that they cannot obtain an education or earn a livelihood by visual methods. Of this number, approximately 85,000 will be found in the states and about 15,000 in the territories and overseas possessions.

The principal causes of loss of eyesight in America, with approximate percentages for each cause, are:

1. Cataract (cloudiness or opacity of the crystalline lens)—25 per cent.
2. Inflammatory and degenerative diseases of the eye affecting the two inner coats of the eyeball (the retina, or nervous inner lining, and the choroid, the blood-vessel or middle coat)—10 or 12 per cent.
3. Optic atrophy (death of the optic nerve)—12 per cent plus.



4. Cloudiness and opacity of the cornea caused by scars from ulcers incidental to birth infections of the eyes (babies' sore eyes), to syphilis, to phlyctenular disease, to accidents, etc., which make it impossible for light to enter the eye—8 per cent.
5. Glaucoma (hardening of the eyeball)—8 per cent.
6. Inflammatory diseases affecting the muscular structures inside and near the front of the eyeball (the iris and ciliary muscle), and often extending to the choroid coat (when the three structures are involved the group term "uveitis" is used to describe the condition)—6 or 7 per cent.
7. Eye injuries (industrial, household and at play)—6 to 10 per cent.
8. Nearsightedness of high degree (progressive myopia)—3 per cent.
9. Trachoma, with its various superimposed infectious processes—from less than 1% in most of the states up to as high as 25% in sections of the Appalachian and Ozark mountains.

This group accounts for approximately 75% of all blindness and includes nearly all affections which are preventable. DeSchweinitz has estimated that at least 25% of blindness is preventable; others have placed the estimate between 30 and 50 per cent.

1. Cataracts occur chiefly in two periods of life: infancy and childhood (for the most part congenital cataract), and after mid-life (old age or senile cataract). Cataracts are neither preventable nor curable by present known methods of drug therapy, but may be removed by simple operative procedure, if the individual's health permits; and good vision may be obtained subsequently by the fitting of appropriate spectacle lenses. *See EYE, AFFECTIONS OF: The Lens.*

2. Loss of vision from disease affecting the two inner lining structures (choroid and retina) and the inside muscles (iris and ciliary body) is generally traced to disease of the whole organism, such as syphilis, diabetes, kidney disease, or to focal infections at the roots of teeth or around tonsils, or to toxic disturbances from retained waste products, etc. Each of these eye conditions must be traced to its origin and, in addition to local measures, treatment must aim to relieve or remove the causal factor.

3. Atrophy of the optic nerve, in more than 75% of the cases, may be traced to syphilis, either untreated or inadequately treated. A certain number of cases may follow injury to the optic nerve or pressure from brain tumor or brain abscess. When syphilis is the causal factor, only complete treatment of this disease may avert blindness. In the syphilitic expectant mother, particularly, adequate treatment for this condition is indicated to save health in general and to avert blindness in both mother and child.

4. Blindness from scarring of the cornea after purulent inflammation, developing a few days after birth, is easily preventable. These cases are gradually becoming fewer with the required use of appropriate

prophylactic drops in the eyes of the baby immediately after birth. With other affections causing ulcers and scars of the cornea, better facilities and newer methods of treatment are reducing the loss of vision. This is true also of injuries to the cornea caused by burns or the lodgment of foreign bodies.

5. The cause of glaucoma, which occurs largely in middle life, has not yet been satisfactorily determined. One type of glaucoma is so acute that immediate surgical relief is generally secured. Unfortunately, the much more common form gives little warning until considerable side vision has been lost; other symptoms are a tendency to see rings or halos around lights, mistiness of vision, and a desire for a change of lenses. In the slowly developing type of glaucoma local remedies often will improve the faulty return drainage from the eye responsible for the hardening process. Most cases sooner or later require surgical aid. Unless this disease is recognized early, blindness slowly but inevitably results. (*See GLAUCOMA.*)

6. With loss of vision caused by disease attacking the inside muscles of the eye (uveitis) whether directly due to syphilis, or to focal infection from tooth socket, abscess or tonsil, or from retained toxins—treatment of the whole system or of the affected part, or both, may arrest progress of the disease. Frequently, prolonged treatment may be indicated.

7. Many industrial accidents caused by flying chips, unguarded machinery and splashes from molten metals and dangerous chemicals are now being prevented by safety guards on machinery and by the use of protective goggles by workmen. Additional precautions and better first-aid facilities may further decrease loss of vision in hazardous occupations. Non-industrial eye injuries may be greatly reduced by better household organization and more careful supervision of the play of children. Legal restrictions on the sale of dangerous fireworks and explosives and "safe and sane" holiday celebrations may still further prevent blindness from accidents.

8. High degrees of nearsightedness in progressive stages (progressive myopia) frequently advance to blindness. Early fitting of glasses, to be worn for all work and usually for all recreation, combined with good hygienic care, may help to arrest progress of myopia. Close eye use may need to be discontinued for a while.

For many children in whom the progress of the nearsightedness is not readily controlled, eye physicians recommend attendance at sight-saving classes. These classes, with their special lighting equipment, desk fixtures, large-type books, etc., careful teaching schedule, and supervised use of correctly fitted lenses, permit visual education without eye damage and inculcate valuable lessons in eye health. For adults change of occupation may be required. In all cases of progressive myopia constant supervision by skilled physicians is desirable.

9. In the absence of a satisfactorily proved cause of trachoma, appropriate medical and surgical care of the afflicted, with follow-up teaching in the home by

public health nurses who know how to improve living conditions, may do much to help. B. F. R.

**BLIND POOL**, a combination of speculators, usually professionals, who pool their capital for a speculative purpose, placing management of the pool in the hands of one of their number for a specified time. Members of the pool have no voice in the management of the pool and are supposed to remain in ignorance of its commitments until expiration of the period of the pool.

**BLIND WORM**, a popular name given to worm-shaped, legless animals which appear to be, or actually are, lacking in functional eyes. It is most frequently applied to the Cæcilians, an order of worm-like amphibians, and to the common European "slow-worm" (*Anguis fragilis*), a reptile. The latter is a harmless lizard, some 15 or 20 in. long, which looks much like a snake. It is nearly related to the American "glass snake" (*Ophisaurus ventralis*). See also CÆCILIAN.

**BLINK MICROSCOPE**, an instrument used for viewing two photographic plates of the same part of the sky in rapid succession, and very efficacious in discovering stars that vary in brightness or have a large PROPER MOTION.

**BLISS, TASKER HOWARD** (1853- ), American army officer, was born at Lewisburg, Pa., Dec. 31, 1853. He was educated at Bucknell University (then Lewisburg University) and at the U.S. Military Academy. During the Spanish-American War he served in the Porto Rican campaign. He was a special envoy in negotiating the treaty of reciprocity between Cuba and the United States, becoming Chief of the Cuban Customs Service in 1898. Having been appointed a member of the Army War College Board in 1902 with the rank of brigadier-general, he became commandant of the board the following year. He became a member of the general staff of the United States army in 1902 and of the Joint Army and Navy Board in 1903. From 1905 to 1909, he held command in the Philippines. He served as president of the Army War College in 1909, becoming assistant chief of staff in that year and acting chief of staff the following year. During the Mexican insurrection (1911) he commanded a brigade on the Mexican border. He became a major-general in 1915 and chief of staff with the rank of general in 1917. He was a member of the Allied Conference and of the Supreme War Council in France, then a member of the American Commission to negotiate peace. He served as governor of the U.S. Soldiers Home from 1920 to 1927.

**BLISTER BEETLE**, any member of the family *Meloidæ*; so called because their bodies, dried and pulverized, have been used to make blister-plasters. The Spanish-fly is the best known in this connection. Adult blister beetles are medium sized insects, rather soft-bodied. Some are black in color, others gray, still others are yellow with black stripes, often seen feeding on garden asters and goldenrod. Several species feed also on the leaves of potato plants, and are sometimes known as old-fashioned potato beetles.

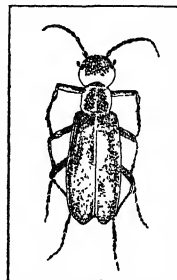
Eggs are laid in the ground in late summer. Larvæ pass through a series of interesting and complicated changes in their development. Some feed on the eggs of short-horned grasshoppers. Others eat the egg and stored food in the cell of a solitary bee. Adult insects appear the following summer.

**BLISTERS**. All CAPITAL SHIPS built since the World War are provided with extensive protection along their sides to diminish the underwater damage from EXPLOSIVES carried by TORPEDOES. Constructions vary considerably, and in some details are confidential. One type utilizes a mass of tightly packed tubes, while another type depends upon the action of liquid, often fuel oil, in a series of small compartments of considerable thickness. It is not essential that the torpedo protection actually protrude from the side, but in ships which did not originally have it, it is more convenient and usual to add it in this way. Torpedo protection, particularly if added afterwards, has therefore commonly been called blisters or bulges.

**BLISTER STEEL**, steel made by introducing carbon into wrought iron by the CEMENTATION process. Bars of the iron are packed in charcoal in an airtight chamber and kept at a temperature of about 1000° C. for at least a week. This treatment causes the carbon to penetrate the metal, forming steel. During the process the carbon reacts with the slag in the iron to form carbonic acid which produces blisters on the metal, hence, the name. Blister steel is not homogeneous and its chief use is in the production of crucible cast steel, a high quality product used in tools and cutlery. See also CRUCIBLE STEEL.

**BLITHEDALE ROMANCE, THE**, the third novel by NATHANIEL HAWTHORNE; published 1852. It depicts the life of a community of idealists similar to the BROOK FARM community of which Hawthorne had been a member. The central character, Zenobia, is an intellectual, exotically beautiful woman, somewhat modeled after the famous Margaret Fuller. She falls under the spell of Hollingsworth, a dynamic, wholly self-centered philosopher of the Blithedale Community. But Hollingsworth has made a conquest of Priscilla, a girl who comes mysteriously to Blithedale. It is revealed that Zenobia and Priscilla are half-sisters. Zenobia, wretched with unappeased love—"murdered" by Hollingsworth—drowns herself. The daily life of Blithedale, where glowing idealists, despite their ardor, make gruel and milk their cows very badly indeed, is sketched realistically and brilliantly. The entire story is seen through the eyes of the autobiographical Miles Coverdale.

**BLIZZARD**, a blinding snowstorm of small flakes accompanied by a strong wind, very dry, and intensely cold, which drives the very fine snow with great force. The wind may continue to blow for several days and cause snow drifts up to 10 feet and



BLISTER BEETLE  
(*Epicauta marginata*)

higher. Blizzards occur but seldom along the coast, and are most frequent in the arctic regions, the great plains west of the Mississippi, and the steppes of Russia and Siberia. They may cause heavy damage and paralyze all traffic for several days; their most frequent occurrence is in the wake of a cyclone in winter.

**BLOCK, ALEXANDER ALEXANDROVITCH** (1880-1921), Russian poet, was born in St. Petersburg in 1880. *Verses to the Beautiful Lady* was the first collection he published. Through the revolutionary poem, *The Twelve*, he sprang into fame. Block wrote also romantic-lyric dramas, of which *The Show* (German *Die Schaubude*) and *The Rose and the Cross* (German *Rose und Kreuz*) have been translated into several continental languages. Block died in 1921 in Leningrad (St. Petersburg).

**BLOCK**, a word used in a general sense to denote a piece of wood, stone or the like, usually solid and having one or more plane or approximately plane surfaces, as building blocks; also used in a general sense to denote a section, as a city block or block of real estate. The word block has numerous specific applications, as butcher's block, a massive wooden table used for cutting meat; and the headsman's block, a piece of wood serving as a chopping block for the executioner.

In practical mechanics a block is a grooved pulley or sheave around which a rope passes (*see* TACKLE), the sheave being mounted in a wood or steel frame, the two parts of which are connected by a metal strap. The frame may be fitted with an eye or hook, so it can be attached to the object to be lifted or to the rope from another block. The classification of blocks depends upon the number of sheaves they contain, thus a single block has one sheave, a double block two sheaves, and so on. In railway signal systems the track is divided into blocks or sections and signals located at the entrance to each block indicate to approaching trains whether the track in that section is clear. These signals are usually in the form of arms or flags mounted on towers alongside the track. When the flag is in a vertical position the track is clear, and when it is in a horizontal position danger lies ahead. These signals may be either automatic or manual in operation.

**BLOCKADE, SEA**, the stationing of a naval force near a port, river mouth or coast of the enemy, and the capture of all merchant vessels, neutral or otherwise, that attempt entrance and egress past the blockading force. Blockades, to be binding, must be effective; that is, maintained continuously by a force sufficient to make the passage dangerous. Paper blockades, or blockades established by proclamation, without stationing an adequate force near the blockaded port, are illegal. In order to justify the detention of a vessel attempting to enter or leave a blockaded port, it is necessary that the vessel should have had notice of the existence of the blockade. This notice may be actual or constructive. Actual notice is notice by the blockading squadron on its station. It is

usually put in the form of a statement indorsed on the register of the merchant vessel by the boarding officer. Constructive notice is notice which may be presumed to have been given either by a proclamation or diplomatic circular of the blockading government, or by the notoriety of the fact. A blockade ceases when the blockading force voluntarily withdraws, or when it is driven off by a force of the enemy. In such cases, a new blockade requires a new notification. If the blockading squadron is only temporarily dispersed by stress of weather and immediately resumes its station, the blockade is not held to have ceased.

R. E. C.

**BLOCK AND TACKLE**, an instrument comprising an arrangement of ropes and pulleys, used to gain the mechanical advantage of force at the expense of speed in lifting or pulling objects. The block comprises a framework, or shell, in which are mounted one or more pulleys, or sheaves, on a pin. A hook and shackle are attached to the block so that it may be fastened to other objects. One or a multiple number of pulleys may be used in a block, according to the ratio in which the speed is to be sacrificed to gain force. Blocks are used in pairs, one being fixed to a stationary object and the other to the object to which the force is to be applied. A rope is attached to a hook on one of the blocks and threaded through one pulley on the other block, then through one in the first block and so on until all the pulleys have been utilized. Then, when a force is applied to the free end of the rope, it is transmitted to the movable block with a magnitude equal to the product of the force applied and the number of times the rope passes between the blocks.

**BLOCK COEFFICIENT** is the ratio of the volume of the DISPLACEMENT of a vessel in cubic feet to the volume of a block having the same length, breadth and mean draft. This coefficient varies for different types of vessels, as for example, those primarily designed to carry cargo have fuller lines and consequently a larger block coefficient (from .7 to .76) than fast Atlantic liners (.6 to .65).

**BLOCK ISLAND**, an island about 10 mi. off the coast of Rhode Island, forming part of the county of Newport, R.I., and the township of New Shoreham. Block Island is a popular resort and has important lighthouses.

**BLOCKS, CONCRETE.** *See* CONCRETE PRODUCTS.

**BLOCK SIGNALS AND SIGNALING.** *See* RAILROAD SIGNALING AND INTERLOCKING.

**BLOEMFONTEIN**, capital of the Orange Free State, Union of South Africa, about 750 mi. from Cape Town. Located on the Cape-to-Cairo railway, the city is a trade center and has numerous industries. It is well laid out and has a handsome cathedral, town hall and museum. Bloemfontein was an important military center in the Boer War and, after being taken by Lord Roberts, became a part of the British Empire in 1900. Pop. 1926, Europeans, 22,695.

**BLOIS**, capital of the department of Loir-et-Cher, central France, on the Loire River, about 40 mi.

northeast of Tours. The town is noted especially for the chateau of the Orléans family, a magnificent Renaissance structure. The history of this chateau in the 16th century is intimately associated with that of all France. Louis XII, Francis I, and Henry III made it their favorite residence; here the Duc de Guise was murdered, Dec. 23, 1588, and Catherine de Medici, a few days later, died. The Cathedral of St. Louis is an uninteresting Gothic work of the 17th century. The chief manufactures of Blois are shoes and chocolate. Pop. 1931, 24,607.

**BLOOD**, the vital fluid which circulates through the heart, arteries and veins, consists of a colorless liquid portion (plasma) in which are suspended a large number of formed elements (cells and parts of cells).

In the earliest stages of development, the living organism does not have a well-developed system through which the fluid is transported (vascular system). The structure and needs of the cells are so primitive that simple passage of fluid from cell to cell meets its requirement. However, with development of the living organism as a more complete structure, this type of organization does not suffice. All the materials which the cell requires must be brought to it and those which are discarded must be carried away. There is further need of rapid circulation so that a simple system of tubes (blood vessels) does not suffice. Consequently, a pump (heart) is developed to make possible a rapid supply of nutrients to the cells of the body and facilitate the rapid excretion of waste products.

The principal chemical materials which living cells require and which are carried to them by means of the blood are as follows:

- |   |  |
|---|--|
| 1. Sugar  | } From the digestive tract                 |
| 2. Protein  |  |
| 3. Fat  |  |
| 4. Salts  |  |
| 5. Water  |  |
| 6. Vitamins                                       |  |
| 7. Oxygen.....                                    | From the lungs                             |
| 8. Secretions of organs and glands (hormones).... | From the pancreas, adrenals, thyroid, etc. |

The cells also excrete (*see* EXCRETION) by means of the blood waste products, such as:

1. Carbonic acid
2. Nitrogenous substances:
 

(a) Urea.	(b) Uric acid.	(c) Creatinin.
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The formed elements of the blood consist of:

1. Red cells—Erythrocytes
2. White cells—Leucocytes
3. Blood platelets—Thrombocytes

Besides taking an active part in the conveyer system which was described above, some of these cells have more specialized functions, such as defense against infection.

**Plasma.** The fluid portion of the blood is called plasma. The total volume of blood in the average

normal adult is about 7 quarts or approximately 10% of the body weight. Of this amount the plasma represents about 4 quarts. The amount of plasma, even in the absence of disease, is subject to a certain variation. If water is withheld for a long time, the plasma volume may be reduced to 2½ quarts (anhydremia) or following the administration of large quantities of water, the plasma volume may increase to 6 quarts (plethora). In health the plasma is clear except after a meal, when it is cloudy from the small globules of fat suspended in it. Ninety per cent of plasma is water. The remainder consists of proteins, salts, sugar in the form of glucose and traces of nitrogen containing compounds, such as UREA, URIC ACID and creatinin. Serum is of the same composition, except that a small fraction of the protein (fibrinogen) is removed when blood is allowed to clot.

The serum is of particular interest in infectious diseases like diphtheria and scarlet fever. The power to neutralize the toxins of these diseases lies in the protein fraction of the serum.

In the commercial preparation of antitoxin the serum of animals is used. The protein of the serum contains substances known as antibodies which serve as protective agents in various infectious diseases (*see* ANTITOXIN).

From the chemical standpoint, the plasma or serum is an albuminous solution of salts in which are dissolved: (1) food substances on their way to the tissues; (2) waste products on their way to the organs of excretion. The basic structure of the plasma or serum (protein, salts, and water) tends to be constant in health. The concentration of food substances—sugar (*see* CARBOHYDRATES), FATS, structural units of the PROTEIN molecule (amino-acids) and waste products (urea, uric acid and creatinin) are less constant and vary with the ingestion of food and the type of food taken.

Plasma or serum has a salty taste and a peculiar odor. The odor varies according to the animal species, and is due to the type and quantity of the excretory products that are present. The reaction of blood is ordinarily slightly alkaline. This is measured only by very delicate methods. Any acidity or alkalinity sufficient to show by the ordinary methods would be incompatible with life.

The formed elements of the blood consist of red blood cells (erythrocytes), white blood cells (leucocytes) and small particulate bodies known as blood platelets or thrombocytes. These cells comprise almost 50% of the total volume of blood.

**Red Blood Cells.** The red blood cells (erythrocytes) are present in greatest numbers. In health the average number is about 4½ to 5 million per cubic millimeter of blood. This number is slightly less for women and is increased in people living in high altitudes. The number in health and at a definite altitude tends to remain constant. Red cells are continually being destroyed and new ones formed. In normal conditions these two processes are equal, so that a constant number is found. When they are

destroyed faster than they are made, a reduced number results (ANEMIA) and inversely an increased number results when they are produced faster than they are destroyed (polycythemia). It has been estimated that the average length of life of a red cell after it leaves the bone marrow is from one to two months.

In shape, the red cell is a circular disc, concave on both surfaces. The membrane surrounding the red blood cell is elastic and the shape of the cell may be passively changed to accommodate itself to its quarters. Its thickness is  $\frac{1}{25,000}$  inch and its diameter

$\frac{1}{3,600}$  inch.

The normal mature red cell appears to be structureless. When the red cells are suspended in a solution of greater strength than that of the blood or when blood is allowed to dry, the cells show small spine-like projections. They are then called crenated cells and are produced by the passing out of the cellular fluid of the red cells (exosmosis). When red cells are placed in solutions weaker than the blood, the water passes into the red cells and they burst, liberating a pigment compound called hemoglobin (hemolysis).

In chemical composition the red cell is 60% water and 40% solids. Ninety per cent of the solids is hemoglobin, which gives the blood its red color. In individual red cells hemoglobin is straw colored and appears red only when seen in thick layers of red blood cells.

The hemoglobin is often called the respiratory pigment, because it transports oxygen from the lungs to all parts of the body. In the average normal healthy individual there are about 2½ ounces of hemoglobin for every pint of blood, and this is spoken of as 100% hemoglobin. However, it may vary considerably. The amount of hemoglobin in health is influenced mainly by the diet. As one of the most important components of this pigment is iron, it is necessary to consume a sufficient amount of iron-containing foods to keep the quantity of hemoglobin normal.

The chief duty of the red blood cell is to carry oxygen from the lungs to the tissues. It is able to carry out this work because of its hemoglobin. Therefore, in conditions where the red blood cells are low in number or where hemoglobin is decreased in amount (ANEMIA), the tissues may suffer from a lack of oxygen (ANOXEMIA).

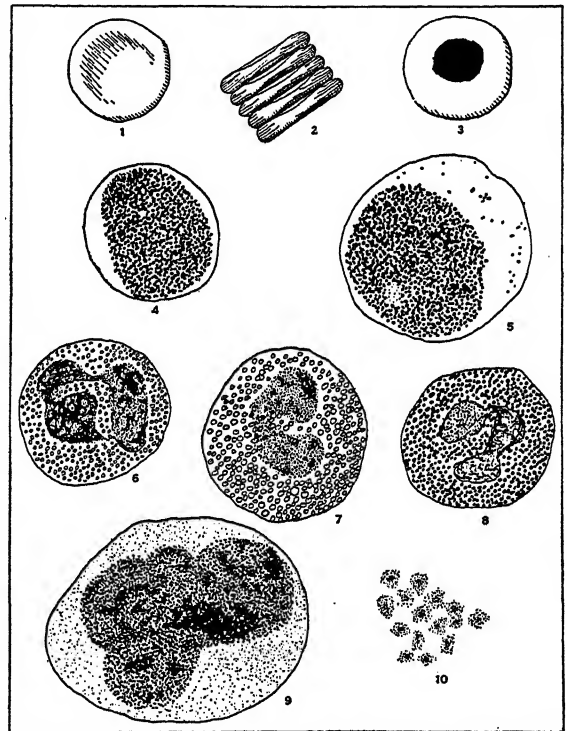
The red blood cells are normally found in the bone marrow. Early in the life history of the individual (embryonic stage) the red blood cells are also formed in the liver and spleen. The parent cell of the red blood cell has a different structure from that of the mature forms seen in the circulating blood. It is larger in size, has a central structure called a nucleus, and does not contain hemoglobin until it has lost its nucleus and become a mature red cell.

When demand is made upon the body for new red blood cells, the bone marrow attempts to supply the blood with finished red blood cells, but if this demand be excessive, the parent tissue has to send

out younger cells (*nucleated red cells*) to meet this emergency. These forms are frequently seen in individuals who have lost a large amount of blood or where blood destruction is out of proportion to blood formation (hemorrhage and hemolytic anemia).

**White Blood Cells.** The white blood cells (*leucocytes*) are fewer in number than the red blood cells. Normally there is one white cell for every 1,000 red cells. In the average healthy adult the number of white cells may vary between 6,000 to 10,000 per cubic millimeter and deviate as much as 4,000 cells during certain periods of the day. There are several types of white cells and these differ in numbers in infants and adults. The two main types of cells are called *lymphocytes* and *polymorphonuclear leucocytes*. In infancy the lymphocytes comprise about 50 to 60% of the total white cells. In the adult the polymorphonuclear leucocyte makes up from 60 to 70% of the total white cells. At the ages of from three to five, the number of these two types of cells are almost equal.

The *lymphocyte* is a cell with a round central structure (nucleus) and non-granular cell body (cytoplasm) (*see CELL*). There are two main types of lymphocytes,



VARIOUS KINDS OF HUMAN BLOOD ELEMENTS

1, Red blood cell (erythrocyte); 2, red cells arranged in rouleaux form as in clotting blood; 3, nucleated red cell of bone marrow which is to form a red blood cell by the extrusion of its nucleus; 4, small lymphocyte; 5, large lymphocyte; 6, neutrophilic leucocyte; 7, eosinophilic leucocyte; 8, basophilic leucocyte; 9, large mononuclear; 10, group of blood platelets or thrombocytes

small and large. The small lymphocyte is about the size of the red cell and has a nucleus which almost fills the entire cell. The majority of lymphocytes in the blood are of the small variety. The large lymphocyte



phocyte is  $1\frac{1}{2}$  times as large as the red cell and has more cytoplasm than the small lymphocyte.

The *polymorphonuclear leucocyte* is the second type of white cell found in the blood, and is about twice the size of a red cell. The nucleus of the polymorphonuclear leucocyte may show many shapes, as the name implies, depending upon the number of divisions in the nucleus. These may vary from one to five divisions. The older the cell, the greater number of nuclear parts. When these cells die they are promptly replaced by young cells. It is estimated that one-fifth of the total die off in 24 hours. The polymorphonuclear leucocyte moves by extending part of its cell body (cytoplasm) in one direction and later the rest of the cell moves up to the point to which the projection has extended. This is called ameboid motion.

There are several sub-types of this class of cell, named because of the characteristic reaction of the granules of the cell body to stains. We, therefore, speak of polymorphonuclear neutrophile, eosinophile or basophile. The *neutrophile* makes up 60-70% of the circulating leucocytes. This cell contains granules which stain neither a decided pink nor blue, but a natural or lilac color. The *eosinophile* is found in numbers from 1 to 4% of the total white cells and is a little larger than a neutrophile. The granules of these cells are large and coarse and stain a deep pink. The name eosinophile indicates its tendency to stain with eosin, a pink dye. The *basophile* is a cell slightly smaller than the neutrophile and comprises about 1% of the leucocytes. The granules are coarse and, with the usual blood stains, stain deep purple. Because the blue part of the stain is basic (alkaline) in reaction, they are called basophiles.

The *monocyte* is a representative of the third group of white cells. These are the largest cells of normal blood, having a diameter of 2 to 3 times that of a red cell. The monocytes comprise 2 to 6% of the total number of white cells in adult life. They range from 8 to 12% in infancy. These cells show a single nucleus, which may be round, oval or horseshoe in shape. The cell body is relatively large and shows very fine stippling. Monocytes are capable of ameboid motion.

All three types of cells in the blood originate from a parent cell located in different tissue.

The polymorphonuclear leucocytes and monocytes engulf bacteria and foreign material and digest it. They also aid in carrying nutrients to the tissues. No definite functions are known for lymphocytes, but they undoubtedly take part in the body's defense against bacteria as well as aiding in absorption of materials from the digestive tract.

The term *leucocytosis* is used to designate an increase in the total number of white cells and *leucopenia* for a decrease. Leucocytosis may be due to an increase in all the variety of cells described, but it is much more common to have one type increased while the others are normal or reduced. The change may be relative, that is, increase in a certain type of cell with-

out increase in total numbers or there may be an absolute increase in total white cells with a certain type predominating. Marked exertion (physical or mental) and cold baths may cause a temporary increase of polymorphonuclear leucocytes. In certain diseases there is a definite and well-marked leucocytosis. It may be said, in general, that INFLAMMATION and INFECTION result in an increase in white cells. The leucocytes migrate to the site of infection and ingest the invading bacteria and destroy them (*phagocytosis*). Certain diseases like measles, influenza, mumps and typhoid fever are accompanied by a decrease in white cells (*leucopenia*). In the absence of these diseases characterized by leucopenia, a low white count in the presence of infection is looked upon as a poor response to infection. The primary function of the white cells is a defense against infection and inflammation.

**Platelets.** The platelets or thrombocytes are not cells, but only fragments of cells. They are probably derived from certain cells in the bone marrow. They are of importance in that they liberate a substance which causes blood to coagulate. In the presence of calcium salts this substance is capable of transforming a protein of the blood, fibrinogen, into fibrin. Persons having a reduced number of platelets may develop spontaneous bleeding or PURPURA.

In some persons the delay of rupture of the platelets results in a very prolonged time for clotting. This condition is called HEMOPHILIA and these hemophiliacs or bleeders may bleed to death from a slight wound. It is hereditary and transmitted by females, though it does not manifest itself in them, but only in their male progeny.

For the respiratory function of the blood *see* RESPIRATION. *See also* ANEMIA; EXCRETION; LIGHT, ARTIFICIAL, IN TREATMENT OF DISEASE; PATHOLOGY; VASCULAR SYSTEM. H.G.P.

**BLOOD ACCUSATION.** *See* RITUAL MURDER.

**BLOODFLOWER** (*Asclepias curassavica*), a handsome perennial of the MILKWEED family, grown as an ornamental in greenhouses in the North and planted in the open in the South. It is a native of tropical America, more or less naturalized in the Gulf States. The plant grows about 3 ft. high, bearing smooth, opposite, lance-shaped leaves and reddish-orange flowers in axillary or terminal clusters (umbels).

**BLOOD GROUPS.** In 1900 it was first observed by Karl Landsteiner (1868- ) that when the serum of certain persons was mixed with a suspension of the red cells from the blood of certain other persons, the red cells were caused to adhere in groups or clumps. This reaction, called agglutination, did not occur between the serum and cells of any two individuals chosen at random, but only in certain instances. It is due to the action of a specific antibody in the serum on a specific receptor in the red cells. Further study indicated that there were two separate receptors of this sort. An individual, therefore, may have in his red cells one of these, or the other, or neither, or both. There are thus four so-called blood groups. They

may be easily demonstrated by serums of known groups. The reactions of the four groups are shown in the accompanying table. As a result of active investigation by workers in all parts of the world, the blood groups have become of practical importance in several ways.

Group	Serum will agglutinate cells of groups	Cells are agglutinated by serum of groups	Old number	
			Jansky	Moss
O . . . .	A, B, AB		I	IV
A . . . .	B, AB	O, B	II	II
B . . . .	A, AB	O, A	III	III
AB . . . .		O, A, B	IV	I

In the transfusion of blood it is necessary to choose a donor whose cells will not be clumped by the recipient's serum. Prospective donors must therefore be chosen either from the same group as the recipient, which is preferable, or from group O which is known as the universal donor, because the cells of such a person will not be clumped by any serum. The action of the donor's serum on the recipient's cells need not be taken into account in transfusions. The use of a donor of an incompatible group results in serious reactions in the recipient, frequently culminating in death.

The receptors in the red cells have been found to be hereditary, and the manner of their inheritance has been thoroughly worked out. The basis of the heredity of the blood groups is a series of three allelomorphs, A, B and O, with A and B dominant to O, but the heterozygote AB recognizable as a separate group. When the blood groups of the father and mother are known, it can be predicted which blood groups may occur in the children and which may not. This becomes of practical importance in the identification of infants which may have become mixed in hospitals. Conversely, when the blood groups of a mother and her child are known, the blood group of the father can be predicted. In this way many cases of disputed parentage are settled. In this connection it must be remembered that a man of the wrong group is definitely not the father of the child, while a man of the right group may be, but cannot be proved to be by this means. Dried blood stains can be dissolved and tested for blood group, so that this technique becomes of value as an aid in the identification of murder suspects. The accompanying table shows the hereditary possibilities in the various types of matings involving the groups.

Blood groups of the parents	Blood groups which may occur in the children	Blood groups which cannot occur in the children
O O	O	A, B, AB
O A	O, A	B, AB
A A	O, A	B, AB
O B	O, B	A, AB
B B	O, B	A, AB
A B	O, A, B, AB	.....
O AB	A, B	O, AB
A AB	A, B, AB	O
B AB	A, B, AB	O
AB AB	A, B, AB	O

Many studies have been made in the search for a relationship between the blood groups and some pathological, anatomical or physiological condition, but no such relationship has as yet been established. In general, animals do not seem to have active blood groups, but the anthropoid apes show agglutination reaction similar to those in man.

The four blood groups occur in definite proportions in any give race of people, and these proportions differ widely between various races. Since the blood groups are definitely inherited, remain unchanged by environmental agencies, are not subject to conscious selection, occur with definite frequencies in any given race, and remain in the same definite proportions through generation after generation in the absence of racial crossing, they are of use as additional criteria in the classification of races. In general, the results from the standpoint of blood groups have coincided remarkably well with classifications based on other and longer known anthropological criteria. The proportions of the four groups in a few selected races are shown below.

Race	Percent. in group			
	O	A	B	AB
American . . . . .	45	42	10	3
English . . . . .	45	43	8	3
German . . . . .	43	43	9	5
Chinese . . . . .	31	25	34	10
Korean . . . . .	31	27	35	7
Negro . . . . .	47	28	20	5
Australian aborigines . . . . .	52	48	0	0
American Indian . . . . .	92	7	1	0

L. H. S.

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**BLOOD POISONING.** See SEPTICEMIA.

**BLOOD PRESSURE,** the force which the column of blood leaving the heart exerts against the wall of the artery. The estimation of blood pressure is helpful in the diagnosis of many diseases. Among the factors which cause a variation in the blood pressure, are age, sex, and the habitat of individuals, as well as the abnormal variation due to systemic disease and disease of the organs of circulation themselves.

Many years ago, the relative pressure was judged by the resistance of the pulse against the pressure of the trained fingers of the physician (see PULSE). At the present time it is generally measured by an instrument called a sphygmomanometer. An empty rubber bag, connected by tube with the manometer or pressure gauge is bound around the arm above the elbow, and air is pumped into it until it completely obliterates the pulse. As the air pressure inside the bag becomes reduced, the pulse again is resumed, and when the first beat comes through, either by hearing it by means of a stethoscope at the elbow or feeling it at the wrist, the listener knows that this is the height of the so-called systolic blood pressure, which is always the upper limit of the blood pressure in the body. After the bag is deflated, the tones become more indistinct

and finally they reappear again, comparable to the normal tones heard at first, and this is the so-called diastolic blood pressure.

Though subject to considerable normal variation in different individuals, and in the same individual under different conditions, inordinately high blood pressure (hypertension) or low blood pressure (hypotension) is a manifestation of a basic change in the circulatory system.

The young adult in the early twenties normally should have a blood pressure of 120 systolic and 80 diastolic. The pressure is normally raised, however, as the individuals grow older and temporarily during periods of emotion or excitement. In certain diseases there is definite increase of blood pressure. If the blood pressure becomes too high, it may cause a rupture in one or more of the blood vessels, especially those of the brain, when **APoplexy** results.

On the other hand, the blood pressure may become lower, in which case the blood stagnates and clots, and apoplexy may result from the thrombosis or "plugged blood vessel" that ensues.

Hypertension is especially associated with kidney disease, due largely to failure of excretion of excess fluids and wastes in the blood. Syphilis causes an increase of blood pressure. Old age lessens the elasticity of the vessel wall, resulting in **ARTERIOSCLEROSIS** and, hence, rise of blood pressure. This condition may be brought on by excesses in living, as well as intoxications, such as lead poisoning.

Hypotension results from fatigue of the heart, from disease, or from fatty degeneration of the heart muscle as in obese individuals (*see* **HEART DISEASE**). Blood pressure is usually lower in **ADDISON'S DISEASE**, in fevers, and wasting conditions in general. Patients may complain of headache and dizziness, of feeling cold, of poor circulation, especially in the feet, and sometimes even swelling of the feet. The individual tires easily, even on least exertion. A sign of special interest is the production of a white line on the skin by drawing the fingernail across it.

Changed blood pressure can often be made normal by various therapeutic procedures, and in hypertension cases rest and freedom from excitement are all-important. In some cases, a moderation in the diet, and a decrease in meat and other proteins is prescribed. In contrast, in the hypotension cases, activity and well-regulated exercise are used to elevate an abnormally low pressure. In both conditions, the factors of disease have to be taken into consideration and in serious advanced disease or old age the pressure condition may be beyond correction. S. A. P.

**BLOODROOT** (*Sanguinaria canadensis*), a small low perennial of the poppy family, with thick, prostrate rootstocks, called also red puccoon. It is one of the earliest and most beautiful wild flowers of eastern North America, growing abundantly in low open woods. Enfolded by a single pale green leaf as it rises from the ground, the flower-bud expands into a handsome pure white blossom. The delicate petals, like those of the poppy, fall soon after opening. The

deeply lobed, palmate leaf attains a breadth of 6 to 10 inches. Both the stem and the fleshy rootstock yield an orange-red, acrid-poisonous juice which contains the alkaloid sanguinarin, used in medicine.

**BLOODSTONE**, a variety of dark green chalcedony sprinkled with small spots of bright red jasper, as if with drops of blood. The finest bloodstone, with distinct and uniform markings, comes almost wholly from India. Inferior specimens are found in Siberia, the Hebrides, and parts of the United States. Bloodstone has been valued as a gem-stone from Babylonian and Egyptian times. Tradition in the early Christian Church associated its origin with the Crucifixion, and as late as the 17th century magical and healing powers were ascribed to it.

**BLOOD TRANSFUSION**, the transference of blood from a healthy person (the donor) to a person in need of normal blood (the recipient), was attempted unsatisfactorily as early as the fifteenth and sixteenth century, but it has been only since 1890 that biological discoveries were made and sufficient fundamental knowledge gained to render transfusion possible and safe. The work of Murphy (1896) and Crile (1906) on blood vessel surgery made possible direct transfusion of blood from the artery of the donor to that of the recipient. The discovery was made by Shattock and Landsteiner (1900) that the serum of one individual may clump the red blood cells of another. To prevent this from happening in the body and plugging up the blood vessels, the compatibility of blood was tested before transfusion. In this direction Landsteiner (1901), Jansky (1906) and Moss (1909) classified all blood into groups according to the interaction of serum and blood cells; if the mixture of serum and a normal salt solution of red blood cells neither clumps nor dissolves, but remains free in suspension, it indicates compatibility. Further, there are the observations of Fishbein (1913) and others that blood of the same species must always be used for transfusion. This excludes the use of animal blood from human transfusion. Lastly, it was possible, through the discoveries of Agote and Lewisohn (1925), to keep extracted blood from clotting by the addition of the proper amount of sodium citrate. This has made it possible to store blood and to inject it into the patient's veins without requiring the presence of the donor.

There are several methods of blood transfusion. The older method of direct transfusion, where the blood vessels of the patient and those of the donor were united, has fallen into disuse. Two of the methods in use at present are as follows: Blood is taken from the vein of the donor into the smallest amount of sodium citrate that will prevent the clotting of blood, and this citrated blood is stored and used when necessary. This was the method used in the World War. The advantage of citrated blood is that transfusion may be performed at the patient's bedside, eliminating the excitability involved in a trip to the operating room. However, when the patient is able to go to the operating room, the method of

choice is to use practically whole blood for transfusion, since any mixture with foreign material is prone to produce reactions. The blood is withdrawn from the donor's vein with a syringe that has been washed in sterile water, normal salt and sodium citrate, and is injected immediately through a needle inserted in the recipient's vein. The entire process should not take over fifteen minutes, and it is seldom followed by reaction.

Blood transfusion has been found beneficial in a variety of diseases. It is particularly helpful for actual HEMORRHAGE, as, for example, in injuries, ruptured ulcers, before and after severe operations, etc. The transfused blood not only replaces the volume of blood the patient has lost, but it also replaces the elements of the blood itself and apparently even stimulates the formation of new blood. Blood transfusion may prove advantageous to people whose blood does not clot, as after a cut or tooth extraction; or in cases of HEMOPHILIA and PURPURA. It is also useful to patients who are extremely anemic (secondary); to those who have become debilitated from chronic diseases and bacterial infections; and to those who have been poisoned with either a chemical or carbon monoxide gas. Blood transfusion is used in pernicious anemia, but it does not have a genuine curative effect upon the disease. Pediatricians find that hemorrhage of the newborn will frequently cease after the injection of normal blood from one of the parents. Many infants who are undernourished improve markedly after similar transfusion.

Blood transfusion performed by modern methods and after the selection of a suitable blood is practically without danger to the patient. It may occasionally be followed by a slight headache or backache, or even a chill, and a mild degree of fever; but these symptoms have usually disappeared by the following day, and the permanent benefit remains.

Donors should be healthy and robust, and tested to ascertain that they are free from syphilis and other communicable diseases. Their blood should belong either to a universal group of donors whose blood is compatible with any of the other groups, or to the patient's own group. A healthy person may lose a pint of blood without feeling ill effects. His blood is restored to normal count in a few days. Professional donors, whose blood has been tested and classified, are listed in hospitals and called upon when required. *See also* BLOOD GROUPS. K. M. H.

**BLOOD, USES OF.** Dried blood is used in FERTILIZERS and animal feeds. It is also used in calf meals as a conditioner. It serves as a plastic for buttons and novelties and, when properly prepared, for certain paints. Blood serum is a source of certain blood albumins used medicinally, as a waterproofing for fabrics such as leather, and as a source of a substitute for egg albumen. It yields a waterproof GLUE for the veneering trade. A high grade of glue is made from blood albumin.

**BLOODY ASSIZES, THE,** began in the summer of 1685 after the collapse of Monmouth's abortive

rebellion against James II. George Jeffreys, Lord Chief Justice, notorious as a stern trial judge and a strong partizan of the King, proceeded to Winchester where he conducted the trials with severity, but probably not with more brutality than was usual at the time. Over 300 persons were executed and many more transported. Jeffreys was shortly created Lord Chancellor.

**BLOODY SHIRTS,** a name given Republican party leaders in northern states who after the Civil War frequently and effectively charged that the Democratic party, through its close connection with the South, was tainted with treason and rebellion, and countenanced the outrages of the Ku Klux Klan. This line of argument was called derisively "waving the bloody shirt," a symbol of bloodshed and outrage.

**BLOOMFIELD,** a town of Essex Co., N.J., situated 11 mi. west of New York City and adjoining Newark on the north. Its transportation facilities include the Erie and Lackawanna railroads, buses and trolley lines. A direct highway connects it with the HOLLAND TUNNEL. There are numerous industries among the varied products of which are textiles, plumbers' supplies, paper, books, thread, razors, emulsions, candy, lamps, pins and motors. In 1929 the manufactures reached approximately \$131,000,000; the retail trade amounted to \$12,935,455. The town is the suburban residence of many New York and Newark business men. Bloomfield, named in honor of General Bloomfield, one-time governor of the state, was incorporated as a separate township from Newark in 1796, and received its charter as a town in 1900. Pop. 1920, 22,019; 1930, 38,077.

**BLOOMING MILL,** a mill in which iron and steel Ingots are rolled into rough bars, or blooms. The blooms are worked into definite forms in a rolling mill proper. Blooming mills are usually arranged so that the ingots are passed back and forth through the same roll stand, being automatically turned after each passage. Special devices are provided for reversing and screwing down the rolls as the size of the bloom is diminished. The most modern mills are driven by giant electric motors connected to the rolls through rugged shafts which sometimes transmit as much as 20,000 h.p.

**BLOOMINGTON,** a city of central Illinois and county seat of McLean Co., 35 mi. southeast of Peoria. The present site was called Blooming Grove in pioneer days and was crossed by several trails; it is now an important railroad center and an intersection point for Federal and state highways. The city's industries serve the agricultural interests of the Illinois corn belt.

In 1929 the value of the local manufactures was about \$16,000,000; the retail trade amounted to \$24,421,588. Its educational institutions include Illinois Wesleyan University, the Illinois State Normal University and the Illinois Soldiers' Children's School. At the state Republican convention in Bloomington in 1856, Abraham Lincoln delivered his "Lost Speech" from

the balcony of a building still standing. Bloomington was founded in 1830. Pop. 1920, 28,725; 1930, 30,930.

**BLOOMINGTON**, a city of south central Indiana, the county seat of Monroe Co., about 50 mi. southwest of Indianapolis. There are railroad and motor bus facilities. The city is located in the Indiana limestone belt. Extensive quarrying and the manufacture of furniture, gloves, baskets, and other products are the chief industries. In 1929 the manufactures reached approximately \$8,000,000; the retail trade amounted to \$12,451,093. The principal crops of the vicinity are corn, wheat and alfalfa. Indiana University, established in Bloomington as a state seminary in 1820, was re-chartered as a university, 1838. The history of Bloomington dates from 1818 when the land was chosen for the county seat; it received a special charter in 1845. Pop. 1920, 11,595; 1930, 18,227.

**BLOOMSBURG**, a town in eastern Pennsylvania, the county seat of Columbia Co. It is situated on Fishing Creek, about 35 mi. southwest of Wilkes-Barre, and served by three railroads. The city is attractively set on high bluffs, commanding a fine view of the surrounding country. It is the seat of a State Teachers College. Bloomsburg is a thriving industrial community manufacturing woolens, silks, carpets, furniture and fountain pens. Farming is the leading rural interest. Bloomsburg was platted in 1802 and incorporated in 1870. Pop. 1920, 7,819; 1930, 9,093.

**BLOUNT, WILLIAM** (1749-1800), American statesman, was born on Pamlico Sound, N.C., Mar. 26, 1749. He received a good education before serving as a soldier and paymaster during the Revolution. He had strong political ambitions, and in 1780-89 he was a member of the state House of Commons, a member of the Senate and twice a delegate to Congress. In 1796 while governor of Tennessee he was elected to the United States Senate but was expelled the following year for complicity in a conspiracy to seize the Spanish owned Floridas and Louisiana for England. He died at Knoxville, Tenn., Mar. 21, 1800.

**BLOWFLY**, a term applied to any one of several species of large flies of the family *Calliphoridae*. The body is often metallic blue or green in color, hence these insects are commonly known as bluebottle or greenbottle flies. They produce a loud buzzing sound in flight. Their eggs are laid upon meat, cheese, carrion, or in some species in exposed wounds and the larvae hatch soon and develop rapidly. The screwfly lays its eggs in wounds



BLOWFLY  
Enlarged

in the bodies of domestic animals, particularly calves, and injury or death of the host may result. The larvae of another species are parasitic upon nestling birds, often causing their death.

**BLOWGUN**, a weapon common in aboriginal America, especially among the Indian tribes of south-

eastern United States, in Central America, in northern South America; it is also used among the peoples of the Malay Archipelago and of Melanesia. The blowgun has many local variations but consists in the main of a long hollow tube of cane or wood from which darts are discharged by blowing with the mouth. The darts also vary considerably, may be pointed or barbed, feathered or undecorated, and are often poisoned at the tip. The butt-ends are usually wrapped with cotton, thistledown or some vegetable fiber. When discharged from the tube the dart is said to fly from twenty-five to sixty yards, varying with the air pressure exerted. The blowgun was used in hunting small game, and is said also to have been used as a weapon of war by some peoples before contact with Europeans.

**BLOWITZ, HENRI GEORGES STEPHEN ADOLPHE DE** (1825-1903), French journalist, was born in 1825 in Bohemia. The frankness of his published opinions twice won him threatened expulsion from France. As Paris correspondent of the London *Times*, he became famous for his sensational feat in publishing the Treaty of Berlin of 1878 at the same time the treaty was being signed in Germany. His knowledge of political designs was several times highly useful to the French Government. Blowitz died Jan. 18, 1903.

**BLOW-OUTS.** See TUNNELING.

**BLÜCHER, GEBHARD LEBERECHT VON** (1742-1819), Prussian field marshal, was born at Rostock, Germany, Dec. 16, 1742. He served in the Prussian army during the SEVEN YEARS WAR, took part in 1772 in the Polish campaign, and proved an expert cavalry leader against the French in 1792. He became general field marshal in 1813, played an important part in the defeat of Napoleon at Leipzig in October of that year, and in 1814 he defeated Marshal Marmont, entering Paris with the allies. The next year in the Waterloo campaign he was defeated by Napoleon at Ligny but retreated in time to join Wellington next day at the Battle of Waterloo. The Order of the Iron Cross was created to reward him. He died in Silesia, Sept. 12, 1819.

**BLUEBEARD**, the leading character in a famous legend first appearing in printed form in a 17th century collection of fairy tales by Charles Perrault. Although Bluebeard has forbidden his wife, Fatima, to open the door to a mysterious room, she disobeys and finds there the bodies of six of her lord's former wives. Bluebeard is prevented from killing Fatima by the timely arrival of her brothers.

**BLUE BEECH** (*Carpinus caroliniana*), a small bushy, wide spreading tree of the birch family, found widely in eastern North America, called also water beech, American hornbeam and ironwood. The short, fluted trunk, sometimes 2 ft. in thickness, with smooth gray bark, divides into numerous slender, somewhat zigzag, drooping branches and sharply toothed leaves, similar to those of the beech. Very early in spring appear the minute flowers, borne in catkins. The fruit, a cluster of small nuts, surrounded by con-



spicuous, leaflike bracts, matures in autumn. Blue beech wood, which is extremely tough and hard, is suitable for levers and tool-handles.

**BLUEBELL**, the name given various plants with bell-shaped, brilliant blue flowers. In England the wild hyacinth (*Scilla nutans*), is called bluebell. The bluebell of Scotland is the HAREBELL (*Campanula rotundifolia*), found widely also in Europe, Asia and North America.



VIRGINIA BLUEBELLS

**BLUEBELLS** (*Mertensia virginica*), called also Virginian cowslip, a very smooth handsome perennial of the borage family, often cultivated as a border plant. It grows wild, mostly on wooded stream banks, from New York and Ontario to Nebraska and southward. The rather stout stem, 1 to 2 ft. high, bears pale green leaves and drooping clusters of showy trumpet-shaped flowers, pinkish in the bud but turning blue on opening.

**BLUEBERRY**, the name given in the United States to various native shrubs of the HEATH family,



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WESTERN BLUEBERRY

(*Vaccinium occidentale*). Flower, flowering branchlet and fruit

prized for their sweet edible berries, those of several species being gathered wild in large quantities for the market. The low early blueberry (*Vaccinium pennsylvanicum*), the first to ripen, grows in Canada and the northern United States. It bears shining,

finely toothed leaves and smooth, usually bluish-black berries, often with a bloom. The sour-top or velvet-leaf blueberry (*V. canadense*), of similar range, bears downy, entire leaves and blue berries with a dense bloom. The late low blueberry (*V. vacillans*), flourishing farther south, has yellowish-green branchlets and rough leaves. Of the late ripening species, the tall blueberry (*V. corymbosum*), growing 4 to 15 ft. high, chiefly in swamps in the eastern United States, is the most productive.

Attempts to bring blueberries into profitable cultivation have been made with considerable success. The tall blueberry, propagated chiefly by cuttings from choice strains, yields the most promising results, often producing finely flavored berries  $\frac{3}{4}$  in. in diameter. It is best grown in boggy areas in an acid soil, but with good drainage.

**BLUEBIRD** (*Sialia sialis*), a handsome song bird of the thrush family common about dwellings throughout eastern North America. It is about 7 in. long, with the back, wings and tail bright blue and the breast cinnamon red. The bluebird breeds from southern Canada to the Gulf coast, building a nest of dried grasses in holes in trees, fence posts and stumps, and often in bird houses provided for it, and laying 4 to 6 bluish-white eggs. It winters from southern New York and southern Illinois southward to the west Indies. Its note is a soft warble becoming plaintive toward autumn. Feeding extensively upon insects injurious to crops and but slightly upon cultivated fruits, the bluebird is a useful resident of orchards and gardens. In the North its arrival, often in February or March, is regarded as a harbinger of spring.



G. M. SUTTON. "BIRDS OF PA." J. HORACE MCFARLAND CO. COPYRIGHT

EASTERN BLUEBIRD

Closely related are the western bluebird (*S. mexicana occidentalis*), with a reddish patch on the back, and the beautiful Rocky Mountain bluebird (*S. currucoides*), with brilliant light blue plumage.

**BLUEBIRD, THE** (*l'Oiseau Bleu*), a fairy play by MAURICE MAETERLINCK; produced 1911. Two children, Tytyl and Mytyle, by the use of a magic jewel, change into personal forms the common things of home—bread, sugar, water, light, cat and dog—and set out in this strange company to find the Bluebird. Their wanderings in dream, through the Land of Memory and the palaces of Night, Happiness and the Future, symbolize humanity's eternal search for happiness. *The Bluebird* is also a fairy tale by the Countess d'Aulnoy, published 1698, of a prince who, for refusing to marry the ugly one of two sisters, is changed into a bluebird.

**BLUEBONNET** (*Lupinus subcarnosus*), a handsome small annual of the pea family, native to Texas

and sometimes planted as a garden ornamental. The stoutish stem bears leaves of five leaflets, which are smooth above and slightly hairy below. The profuse blue flowers, borne in short, scattered, terminal clusters, have an erect broad standard spotted with yellow or white at the center. Blossoming in early spring, often in March, the bluebonnet covers vast areas with azure bloom. It is the state flower of Texas.

**BLUE CURLS** (*Trichostema dichotomum*), a much branched slightly aromatic annual of the mint family, called also bastard pennyroyal. It grows widely in dry sandy soils in the eastern United States, blooming from July to September. The stiff some-



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**WESTERN BLUE CURLS**

(*Trichostema lanceolatum*). A valuable honey plant of the Pacific States. Flowering branchlet, flower and upper part of stamen (upper right)

what sticky-woolly stem, about 2 ft. high, bears entire leaves and attractive blue, pink, or white flowers, with prominent, long curled violet-blue stamens. Several related species, as the woolly blue curls (*T. lanatum*), grow in the Pacific states.

**BLUEFIELD**, a city of Mercer Co., W.Va., on the southern state line, about 75 mi. west of Roanoke, Va. The highest city of the two Virginias, it has at one point an altitude of 2,612 ft. The Norfolk and Western Railroad, the Lakes-to-Florida Highway, and an airport serve Bluefield. It is the distributing center for the Pocahontas Coal Field, and mining activities have contributed greatly to its growth of industries. The city's numerous manufactories include woodworking plants. In 1929 the factory output reached approximately \$5,000,000; the retail trade amounted to \$11,259,938. Bluefield Colored Institute, a state normal school for Negroes and Bluefield College, a Baptist junior institution, are located here, and points of interest near by include Pinnacle Rock, 8 mi. to the

north, Burke's Garden to the south, scenic highways of the Alleghany Mountains and mineral springs. Bluefield was founded in 1887 and named for the fields of bluegrass which occupied the site; it was incorporated in 1889. Pop. 1920, 15,282; 1930, 19,339.

**BLUEFIELDS**, a city of NICARAGUA, situated near the mouth of the river of the same name, and across the bay from El Bluff, its port. Bananas—the town is becoming a center for a large banana industry,—cattle, lumber and tobacco from the districts nearby are brought to the port by river steamers. The business houses, banks and homes of foreign residents are in the center of town and are protected by United States Marines from the frequent revolutionary uprisings in the country. Est. pop. 1931, 7,266.

**BLUEFISH**, a valuable marine food fish (*Pomatomus saltatrix*), allied to the pompanos, found along the Atlantic coast from Maine to Texas and also in the Mediterranean Sea and the Indian Ocean. It is deep bluish above and silvery white below, with a rather stout body, large mouth, projecting lower jaw and prominent canine teeth. It grows usually 20 to 30 in. long and weighs from 3 to 5 lbs., but sometimes attains much greater size. The bluefish is one of the most active, voracious and bloodthirsty of fishes. Traveling in schools, it devours and often wantonly destroys immense numbers of mackerel, herring and other forms of marine life. Because of the excellent quality and flavor of its flesh, the bluefish ranks among the most highly prized of table fishes. Although varying greatly the annual catch marketed in the United States usually exceeds 3,000,000 pounds. See also POMPAÑO; ANGLING.

**BLUE FLAG**, the name given to the common wild IRIS (*I. versicolor* and *I. virginica*), of eastern North America, with violet-blue flowers, and also the lilac and purple irises grown as ornamentals in gardens and yards.

**BLUE GRASS** (*Poa pratensis*), called also Kentucky blue grass and June grass, an exceedingly valuable forage plant, native to north temperate regions and widely cultivated for pastures and lawns. It is a smooth perennial, with erect stems (*culms*), 1 to 3 ft. high, bearing soft flat leaves and an open flowering panicle, 2 to 4 in. long. Throughout the moist regions of the northern United States and adjacent Canada, wherever the soil contains an abundance of lime, blue grass is the standard pasture grass. It flourishes from New England to Virginia and westward to Ontario and Nebraska and also in the humid valleys of the Pacific coast from California to British Columbia.

**BLUE GRASS REGION**, a district in Kentucky, centering around the city of Lexington, largely devoted to stock raising and famous for its thoroughbred horses. The name is derived from the prevalence of blue grass which grows luxuriantly in this limestone region of gracefully undulating hills. The grass (*Poa pratensis*) blossoms with a tiny bright blue flower about the middle of June. It grows from a few inches to two feet in height and forms a thick soft sod which makes excellent winter and summer pasturage.

**BLUE GROUND**, the slaty-blue, brecciated PERidotite, or kimberlite, occurring in intrusive plugs or "pipes" in which diamonds are found in South Africa and in Arkansas. At the surface it weathers to "yellow ground." See also DIAMOND; BRECCIA.

**BLUE GUM** (*Eucalyptus globulus*), a large tree of the myrtle family native to Australia and extensively planted in warm regions for timber, ornament, wind-break and quick shade. It is one of the most rapidly growing hardwood trees, but thrives only in districts where there are no killing frosts. The heavy, exceedingly strong wood, which is resistant to borers, is used for mining timber, flooring and furniture. Eucalyptol, an essential oil highly valued in medicine, is obtained from the leaves. The tree, which attains a height of 100 ft. within 10 years after planting, is said to grow sometimes 300 ft. high. From time to time it sheds its bark in long strips or sheets leaving the trunk smooth, grayish or bluish-white. In 1865 the blue gum was introduced into California where it is widely used for general planting. See EUCALYPTUS.

**BLUE ISLAND**, a city of Cook Co., Ill., 16 mi. south of Chicago Loop district, on the Calumet-Sag Channel. A number of railroads serving the city have yards and machine shops at Blue Island. It was the scene of early activities of the railroad of 1894. Its leading industries include brick-making. In 1929 the factory output was valued approximately at \$9,000,000; the retail trade amounted to \$9,364,072. The city is semi-residential, being well situated on an eminence above the prairie locality. Blue Island was incorporated as a city in 1902. Pop. 1920, 11,424; 1930, 16,534.

**BLUE JAY** (*Cyanocitta cristata*), a strikingly handsome bird of the crow family common in eastern North America. It is about one foot long, with a conspicuously crested head, and brilliant blue wings and tail, variously marked with black and white. The blue jay breeds from southern Canada to the Gulf

States, residing the year round except in the far north. It frequents woodlands and clearings, building a bulky nest of twigs usually in the fork of a tree and laying 3 to 6 pale green or ashy eggs marked with brown. Noisy and restless, the blue jay moves about in small companies, and takes delight in mobbing larger birds, especially hawks and owls. It has numerous whistles and other calls, a loud "jay, jay," being the



G. M. SUTTON. "BIRDS OF PA."  
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BLUE JAY

most common. It often imitates many other birds. The blue jay is an omnivorous feeder, living chiefly upon nuts and seeds, but also destroying many injurious insects and, in the breeding season, devouring the eggs and young of various more useful species.

**BLUEJOINT GRASS** (*Calamagrostis canadensis*), a tall reedlike, perennial grass, growing from 2 to 5 ft. high, common in swamps and low grounds from New England to Oregon and northward to the arctic circle. It is extensively cut for wild hay, especially in Wisconsin and Minnesota, but is of little importance for grazing. Bluejoint is the most abundant grass in the interior of Alaska.

**BLUE LAWS**, laws which are intended to regulate the morals and manners of individuals in the community. Blue was the color adopted by the Scotch Covenanters as their standard in the 17th century. From its use by these people, who were committed to a strict social supervision of the individual's manner of living, the name blue was applied derisively to other groups who sought to repress individual liberty, and the title Blue Laws was applied to the earliest legal code of the colony of New Haven in 1640.

**BLUE RIDGE MOUNTAINS**, a long mountain ridge traversing Maryland, Virginia and North Carolina, and forming the easternmost division of the Appalachian system. It reaches its highest point in Virginia with the Peaks of Otter which attain an altitude of 4,000 ft. In North Carolina the ridge broadens into a plateau which has several ranges on its summit, principally the Cowee, Black and Smoky mountains which run transversely to the northeast-to-southwest trend of the main ridge and are subordinate to it. The Blue Ridge is one of the oldest uplifts in the United States and is characterized by moderate slopes and rounded summits overgrown with hickory, chestnut, oak and maple.

Some of the most beautiful scenery of the Appalachians is found in the Virginia section of these mountains. At historic Harpers Ferry the Potomac River has cut a water gap nearly 1,000 ft. deep through the ridge; and at Balcony Falls the James River flows through a similar passageway. Near Lexington is the famous Natural Bridge, an arch of stone 100 ft. wide, 215 ft. above the stream it crosses and 90 ft. across. In the Shenandoah Valley are the weird natural wonders of Shenandoah Caverns, Endless Caverns, the Blue Grottoes and the Cyclopean Towers. The region abounds in historic landmarks and associations with Colonial and Civil War days.

**BLUE SKY LAWS**, a name popularly applied to statutes enacted by many states for protection of the investing public from worthless, fraudulent and doubtful securities. With the increased use of stock as a means of obtaining funds for carrying on business, crooked promoters preyed on credulous investors to an extent that the principle of CAVEAT EMPTOR left investors at the mercy of stock swindlers. Kansas passed the first Blue Sky Law in 1911. This was followed by other states and in 1912 and 1913 Blue Sky acts were passed in 22 states. Under such laws securities may not be offered for sale without a permit from the state, the dealer must obtain an annual license after satisfactorily answering a strict questionnaire and the secretary of state must be satis-

fied that the proposed offerings of securities will not constitute a fraud upon the purchaser.

**BLUESTEM GRASS** (*Andropogon*), the name applied to two important North American forage grasses. The little bluestem (*A. scoparius*), an erect bunch-grass, 2 to 4 ft. high, common in the eastern half of the United States, usually forms a part of prairie hay. The more valuable big bluestem (*A. furcatus*), of similar distribution, growing 4 to 6 ft. high, is the chief constituent of prairie hay in the western part of its range.

**BLUETS** (*Houstonia cærulea*), a delicate perennial of the madder family, called also Quaker ladies



BLUETS

and innocence. It is found widely in eastern North America in moist grassy places, frequently covering large areas with its whitish blooms. The slender stems, from 3 to 6 in. high, surrounded at the base by dense tufts of small light green leaves, produce from early spring to midsummer a succession of dainty, salver-shaped flowers, varying from light blue to nearly white, with a yellow center.

**BLUE WEED**, a name applied to the VIPER'S BUGLOSS, a bristly biennial of the borage family planted for its brilliant blue flowers and also widespread as a weed.

**BLUFFTON**, a city in northeastern Indiana, the county seat of Wells Co., situated on the Wabash River 24 mi. south of Fort Wayne. The New York, Chicago and St. Louis Railroad and two electric lines serve the city, which has lumber and iron products factories, saw and planing mills. Bluffton was founded in 1837 and incorporated in 1849. Pop. 1920, 5,391; 1930, 5,074.

**BLUNT, KATHERINE** (1876- ), American educator, was born at Philadelphia, Pa., May 28, 1876. She graduated from Vassar College in 1898, took her Ph.D. at the University of Chicago in 1907, and studied at the Massachusetts Institute of Technology, 1902-03. She was on the chemistry faculty at Vassar from 1903-05 and 1907-13, and successively assistant professor, associate professor, professor, and chairman of the home economics department at the University of Chicago, 1913-29. In the latter year she became president of the Connecticut College for Women.

**BLUNT, WILFRID SCAWEN** (1840-1922), English poet, was born at Petworth House, Sussex, Aug. 17, 1840. He studied at St. Mary's, Oscott, and after 1858 served as attaché of the British Embassy in Greece, Spain, France and Portugal. Blunt traveled extensively, particularly in Egypt and Arabia, and presented his views on Mohammedanism in *The Future of Islam*, 1888. As a poet he is best known by *Love Songs of Proteus*, 1880, and *The Wind and*

*the Whirlwind*, 1883. Blunt died at Crabbet Park, his estate in Sussex, Sept. 10, 1922.

**BLUNTSCHLI, JOHANN KASPAR** (1808-81), Swiss jurist, was born at Zurich, Mar. 7, 1808. He was educated at Berlin and Bonn universities and in 1833 became professor at the new university at Zurich. He was professor of civil and international law at Munich and at Heidelberg in 1848-71. In 1852 he wrote *Allgemeines Staatsrecht*. He died at Karlsruhe, Oct. 21, 1881.

**BLYTHERVILLE**, a city and the county seat of Mississippi Co., in northeastern Arkansas, about 70 mi. north of Memphis, Tenn. Three railroads and bus and truck lines serve the city. The region produces cotton, corn, truck garden produce, poultry and live stock in abundance. The chief industries of the city are cotton and lumber products manufacture. The retail trade in 1929 amounted to \$5,862,016. Blytheville is the cotton buying center of the state. Pop. 1920, 6,447; 1930, 10,098.

**B'NAI B'RITH**, a Jewish fraternal order, founded Nov. 1, 1843 by German Jews in America, the largest and oldest organization of its kind. The first Grand Lodge was organized in New York in 1851. The organization spread rapidly and was soon distributed over the United States, Germany, Austria, Hungary, Egypt and Palestine. Political and religious discussions were banned in order to promote harmony and peace. In 1930 the B'nai B'rith had a total membership of 74,490 and was divided into 492 lodges and 11 grand lodges, 7 being in the United States. Monthly reviews are published by the various grand lodges, and since the war the B'nai B'rith has acted as an agency for the relief of persecuted Jews in Europe.

**BOA**, any member of the reptilian subfamily *Boinae*. These snakes, though including only approximately 55 species, are, nevertheless, diverse in form, varied in habits and widely distributed over the earth. One genus of moderate size (*Enygrus*) is found in the Pacific region, while two other genera, both containing single species, are confined to Round Island near Mauritius. The sand boas (*Eryx*) are distributed from central Asia southwestward through much of Africa. The remaining genera belong almost exclusively to the New World, though two of them have representatives in Madagascar. This wide and irregular distribution bespeaks an ancient origin.

The boas range in size from the great anaconda to the tiny snakes of the genus *Trachyboa*. Most of the forms are large, water-loving forest dwellers, but the rubber and rosy boas (*Charina* and *Lichanura*) of the extreme western United States and northern Mexico and the Old World sand boas inhabit dry sandy regions and deserts. The habits of constricting the prey, as well as of subsisting largely on mammals and birds, are quite universal throughout the group.

Of all the species, the boa constrictor (*Constrictor constrictor*) is undoubtedly the most familiar. This handsome snake inhabits tropical America and is

frequently exhibited by professional snake charmers. Fully grown examples are only 10 to 12 ft. long. The true giant of New World snakes is the anaconda or water boa (*Eunectes murinus*), rivaled only in size by the reticulated python of the Malay region. Both of these snakes attain a length of fully 30 ft. Another South American boa (*B. canina*) is remarkable in having a series of transverse, middorsal white spots on a brilliant green background. It is arboreal. The Cuban boa (*Epicrates angulifer*) reaches a length of 12 ft. and is confined to Cuba and the Isle of Pines.

C. H. P.

**BOABDIL**, the last king of the Moors in Spain. The spot where he is said to have looked for the last time on Granada, his capital, after surrendering it in 1492 to Ferdinand of Castile, is known as "The last sigh of the Moor."

**BOADICEA** or **BOUDICCA** (?-62 A.D.), the wife of Prasutagus, king of the Iceni, a tribe of eastern Britain. On the death of Prasutagus, in 60 A.D., his vast wealth fell to his daughters and to the emperor Nero. But the entire property was seized by the Romans and Boadicea and her daughters were subjected to outrageous treatment. In revenge Boadicea led the Iceni and the Trinobantes against the Romans, and razed the Roman colony of London. Soon afterwards Paulinus, the Roman governor, collected a force of trained legionnaires, and moved against Boadicea's army of barbarians. Though greatly outnumbered, the Roman force, protected by bucklers from darts and arrows, won the field with but slight losses. Rather than submit to the victors, Boadicea committed suicide. Her courage and daring have been celebrated in verse by Cowper and Tennyson.

**BOAR, WILD**, the male of swine; specifically of the wild pig (*Sus scrofa*), ancestor of domestic swine. This native species still inhabits the wilder forests of Europe and east to China, dwelling in forests and subsisting on acorns or local fruits, and ravaging cultivated fields. When fully grown, a boar measures  $4\frac{1}{2}$  feet in length, has a massive body and a head armed with long canine tusks, which grow from the root as fast as worn. Clever skill and indomitable courage in using these weapons make these truculent beasts almost masters of the jungle. Boars persist in Europe and are hunted on foot with spears and large dogs (boar hounds), and in the East great numbers are taken and killed in nets, or in the sport "pig-sticking," where the sportsman on horseback tries to spear the boar before it can overthrow horse and rider, or inflict fatal gashes.

E. I.

**BOARD FOOT**, a measure of volume containing 144 cu. in., or comprising a piece of lumber one foot square and one inch thick, used in measuring logs and lumber. The approximate number of board feet in a log may be calculated by means of the formula  $[\frac{1}{4}(d-4)]^2L$ , where  $d$  is the diameter of the log, inside the bark at the small end, in inches and  $L$  the length of the log in feet. The "4" represents the amount deducted to allow for slab when the log is sawed into planks.

**BOARDMAN, HAROLD SHERBURNE** (1874- ), American educator, was born in Bangor, Me., Mar. 31, 1874. He graduated from Maine State College in 1894, and from the Massachusetts Institute of Technology and the University of Maine in 1898. After several years as draftsman and designer of bridges, he entered the engineering faculty of the University of Maine in 1901. He became head of the civil engineering department there in 1904; dean of the College of Technology, 1910; acting president, 1925; and president, 1926.

**BOARD OF EDUCATION.** The administration of schools in most cities or school districts is directed by a local school board, generally termed Board of Education. Practically every state also has a board of education responsible for directing the policy of its state school system. While in the majority of cases, the members of state and local boards are appointed, in a few localities they are elected. In some cities the board of education is dependent on the approval of its budget by the city government, but in general the board has the power to levy its school taxes.

See E. P. Cubberley, *Public School Administration*, 1916.

**BOARD OF INSPECTION AND SURVEY, U.S. NAVY**, a naval body composed of a flag officer and other officers representing engineering, ordnance and aviation and a recorder. It conducts examination and trials of vessels as directed, at least each three years, and also inspects and examines vessels on return from foreign stations. It makes military inspections when directed to do so by the Secretary of the Navy.

**BOARD OF TRADE**, a voluntary organization usually composed of prominent merchants, bankers, and manufacturers of a community. It is similar to a **CHAMBER OF COMMERCE** in its civic interest in the improvement of parks, schools, and streets as well as in the promotion of economic advancement by encouragement of better street car lines and bus routes, and greater industrial activity. The term is used in a different sense as referring to the Chicago Board of Trade, the world's greatest speculative grain market. A Board of Trade is not to be confused with a **TRADE ASSOCIATION**.

**BOARDS, ADMINISTRATIVE.** In the United States these are sometimes composed of three or more members for the joint or collegiate management of a unit of administration. Where the members are salaried, full-time appointees, such boards are preferably called commissions. Such are the Interstate Commerce Commission, the United States Shipping Board, and the Federal Trade Commission. Such commissions frequently have legislative and judicial powers as well as administrative.

Another type of board much employed in the United States for the conduct of educational institutions and endowments consists of bodies of trustees, regents, directors, or governors variously appointed who constitute the legal corporation and who appoint the executive head and other personnel. *Ex officio*



boards are made up of several state or municipal officers and are frequently created by statute. They usually have a secretary, or one active member who directs the administration for which the board is responsible.

**BOARDS, ADVISORY.** Some governments which entrust great powers to a minister or other executive, attach to his office boards of informed or eminent persons who may aid by experience and counsel. In some cases the responsible executive must listen to or consider the advice before acting, though the decision and responsibility remains his. The French Government employs many such advisory boards or councils. The Council of India, advisory to the British Secretary for India, is an example. Advisory boards are rarely employed in the United States.

**BOAS, FRANZ** (1858- ), American anthropologist, was born at Minden, Germany, July 9, 1858. He studied at Heidelberg and other German universities and explored Baffin Land in 1883-84. He taught geography at Berlin University in 1885-86, returning to the United States in 1888 to become instructor in anthropology at Clark University and, in 1899, professor of anthropology at Columbia University. He served in 1901-05 as curator of anthropology of the American Museum of Natural History, New York City, and conducted an anthropological expedition to Mexico in 1910-12. Dr. Boas undertook important studies of American Indian tribes and was a member of the Jesup North Pacific Expedition for research. His authoritative works on anthropology include *The Mind of Primitive Man*, 1911, *Changes in the Form of Body of Descendants of Immigrants*, 1911, and *Anthropology in Modern Life*, 1928.

**BOAT**, a term covering a variety of small craft propelled by oars or paddles, or by small sails or by engines. Below are various craft, which broadly may come under the heading boat.

**Bumboat**, a wide boat used for carrying provisions, fruit and various products, to sell to vessels lying at anchor in a harbor or off shore. In Holland this name is sometimes given to a boat used by fishermen.

**Bugeye**, a small sailing vessel with one or two masts raked aft, the main sails being triangular in shape, with a similar shaped jib. This rig is popular on the Chesapeake Bay, where schooners 70 ft. and longer are used for fishing and other purposes.

**Canoe**, a light boat built of bark, hide or canvas with wood frames, or made by digging out a log, that is propelled by paddles without permanent supports. Canoes are largely used on lakes and rivers.

**Catamaran**, two or three logs fastened together, by a platform on which a mast with a sail is installed. This type of craft is particularly suited for certain waters, as around the West Indies and Fiji Islands.

**Catboat**, a small one mast sailing craft, with mast stepped forward nearly to the stem and carrying one large main sail.

**Coracle**, a light one man boat, with a wicker frame covered with skins, used by fishermen in parts of Wales and Ireland.

**Dhow**, a one mast lateen rigged sailing vessel with a large deck aft, used in the Indian Ocean and Red Sea.

**Dinghy**, a small light row boat, with a square stern.

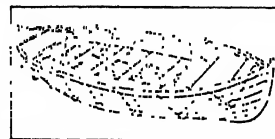
**Dugout**, a term often applied to a log that has been hollowed out into a canoe.

**Houseboat**, a flat bottom boat with house, enclosing living quarters. Houseboats are seldom equipped with sails or motor and are usually moved by being towed.

**Kayak**, an Eskimo canoe having a wood frame covered with hides, except for a small opening in the top, where the man sits. Around the opening is a flap, that is lashed to the man, thus preventing water from entering the canoe.

**Launch**, a large open boat propelled by oars or sail, or by steam or electricity in which case it is called a steam launch or an electric launch, respectively.

**Lifeboats**, open boats, built of wood or metal. For United States vessels, lifeboats come under the jurisdiction of the Steamboat Inspection Service in regard to their design and construction.



COURTESY COSTON SUPPLY CO.

METAL LIFE BOAT

**Lugger**, a small vessel with two or three masts having lug sails. This rig is common for yachts and fishing vessels in France and England.

**Motor boat**, an open or decked over boat, driven by a motor (gasoline or Diesel engine). This term is generally given to a motor propelled craft with no sails, up to about 80 ft. in length. Many motor boats are built of mahogany, equipped with high power engines giving a speed of 20 miles or more per hour, and are luxuriously fitted out.

**Pirogue** or **Piragua**, a dugout made from a log, that is split and the two parts connected by planks. One or two masts are installed with sails. Pirogues are used in waters around Central and South America, and the West Indies.

**Proa**, a sailing canoe consisting of a main hull with a single mast and large triangular sail, to which is attached a small outrigger of the same shape as the main hull. Proas are used in the Malay Archipelago.

**Sampan**, a light boat, with the center and sometimes the after part covered with a matting serving as a protection from the weather, that is propelled by a sail or by a scull at the stern. Sampans are common along the coasts of Japan, China and Java.

**Tugboats**, small wood, steam or motor propelled vessels for towing lighters, steamers and various craft around harbors. For coastwise service they are often built with steel hulls, and with larger engines than those for harbor use.

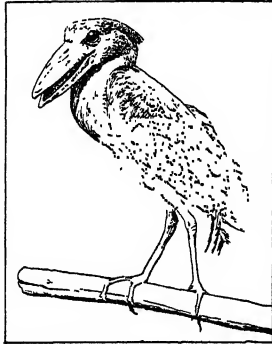
C. H. HU.

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**BOAT, INCENSE**, a vessel which contains the incense before it is placed in the THURIBLE, and which is so called on account of its shape.

**BOATBILL**, the common name for a genus (*Cochlearius*) of heron-like wading birds with very large,

broad bills in shape somewhat resembling an over-turned boat. There are two species frequenting thick woods along rivers and mangrove swamps in Central and South America. They are somewhat gregarious in habit and feed chiefly upon small aquatic animals which they scoop up with their large beaks from the mud in shallow waters. Their note is a harsh croak or squawk.



BOATBILL

The South American boatbill (*C. cochlearius*) ranges from Brazil to Guiana, Colombia and Ecuador. It is about 16 in. long, grayish above and rusty brown below, with a conspicuous crest of long plumes. The Central

American boatbill (*C. zelandoni*), a similar but somewhat larger and browner bird, with a shorter crest, occurs from Mexico to Panama.

**BOAT DESIGNING AND BUILDING**, here the same procedure is followed only in a simpler way as outlined in **SHIPBUILDING**, wood being used instead of steel plates and shapes. Arrangement drawings are prepared, calculations as displacement and stability (see **NAVAL ARCHITECTURE**) are made, and the boat built with wood transverse frames, keel, planking and equipped with sails and motor, according to the plans.

As to the lines or underwater shape of the hull, there has been a marked change in the past few years. Instead of as at one time, designing a boat to cut through the water, now it is designed to lift and skim over the surface. This, with the development of high speed engines has greatly increased the speed of Motor Boats.

As regards the construction, this consists of many small transverse oak frames, fastened to fore and aft members, and in addition may be planked inside. As to the outside planking, this may be carvel or flush, clinker or overlapping, or diagonal consisting of two layers running in opposite directions. For high grade boats the planking is of mahogany, copper fastened.

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**BOB CAT.** See **LYNX**.

**BOBOLINK** (*Dolichonyx oryzivorus*), a common song bird belonging to the family blackbirds and orioles (*Icteridae*). At the breeding season the plumage of the male is a handsome mixture of black, white and buff, while that of the female is buff streaked with black, as is that of the male throughout the remainder of the year. The bobolink, which slightly exceeds the bluebird in size, breeds from southern Canada to West Virginia, Missouri and Nevada, nesting on the ground in fields or meadows, laying 4 to 7 heavily marked whitish eggs. At this period, during which the male utters his voluble ringing song, which is enshrined

especially in the literature of New England, the bobolink subsists chiefly upon weed seeds and insects. Migrating slowly southward in great flocks during late summer, it fattens on the wild rice in marshes, particularly along the coasts of Maryland and Virginia. There, under the name of reedbird, it was formerly prized for the table. It passes gradually on, inflicting some damage to cultivated rice fields in the South, where it is called ricebird, and in October departs for its winter home south of the Amazon.

**BOBRUISK**, a city in the central part of the White Russian S.S.R., halfway between MINSK and GOMEL, situated on the Berezina River in western Russia. Due to its geographical position, railroad connections and roads, the city is an important military center. There is considerable trading in lumber and grain. A large veneering works, saw-mills, a radio station, flour mills and iron foundries are among the leading commercial projects. Strongly garrisoned by Alexander I, Bobruisk proved invulnerable to the repeated attacks of Napoleon. The city is the site of an ancient fortress. During the 1917 revolution, it was the scene of struggles between Whites and Reds. The population is 50% Jewish, with White Russians in the minority. Pop. 1926, 51,385.

**BOBWHITE** (*Colinus virginianus*), a well-known North American game bird commonly called quail in the North and partridge in the South. It is about the size of a robin, with a short tail, reddish-brown above and whitish or buff below, more or less barred with black, and having a conspicuous throat patch, white in the male and tan colored in the female. The bobwhite is found in woodlands and pastures practically throughout the eastern United States and has been introduced in many parts of the West. Feeding largely upon weed seeds and destructive insects, though sometimes upon grain, this bird on the whole renders great service to the farmer. It builds a simple nest on the ground,



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BOBWHITE

usually with a natural archway of herbage, and lays 9 to 18 whitish eggs. In the South two or even three broods of young are often reared in a season. Bobwhites are sociable in nature, moving in small companies or coveys and roosting in a huddle on the ground, tail to tail, ready to fly at the slightest alarm. They derive their name from the clear whistle "ah-bob-white—" of the male. Prized highly for their flesh, they are hunted as game in the South but in the Northern States they are classed as songbirds. They are raised to some extent by commercial game-breeders for restocking depleted coverts. Thousands of a smaller, grayer variety of bobwhite have been imported from Mexico for the same purpose.

**BOCCACCIO, GIOVANNI** (c. 1313-75), Italian author and humanist, was born about 1313, the illegitimate son of a French woman and a merchant of Florence. His birthplace may have been Paris, but at an early age he was in Florence in his father's charge and was studying with a grammarian of some note. His law studies went unused in practice, and at about 17 Boccaccio was in Naples, working there for a merchant. In Naples he wrote several minor works, including the *Teseide* and the *Filocolo*, but nothing really important till he produced the prose *Fiammeta*. This romantic piece was inspired by Boccaccio's passion for Maria d'Aquino, the illegitimate daughter of King Robert the Wise, and it embodies the supposed complaint of the beloved at their separation. The *Fiammeta* was followed by the *Florentine Nymph*, a mythological work in verse. About 1348 Boccaccio began his masterpiece, the *DECAMERON*.

In the *Decameron*, or *Ten Days' Entertainment*, a company of ladies and gentlemen repair to a villa and there pass their time gaily in telling stories. They have fled from the plague which rages in Florence and the shadow of which hangs over the story tellers. Boccaccio's description of the plague is famous and gives an added sense of reality to the work. There are 100 stories in all, and, in keeping with the moral freedom of the author's day, some are indelicate to modern taste; others, such as *The Jew Abraham*, *The Pot of Basil*, *The Stone of Invisibility* and *Griselda*, have passed into immortal literature. For its immense variety, its portraits of all classes and types of contemporary society, its naïve lively humor and its rich human sympathy, the *Decameron* comes naturally to be compared with Chaucer's *CANTERBURY TALES*. As the first notable prose work in the Tuscan idiom, it occupies a pre-eminent place in Italian literature.

The last half of Boccaccio's life was of a more serious nature, and was characterized by his humanistic studies and his intimacy with PETRARCH. He was instrumental in spreading the study of Greek and the Greek classics, and his last years were occupied in writing the first biographical account of DANTE. Boccaccio died at Certaldo, Dec. 21, 1375. See also *ITALIAN LITERATURE*.

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**BOCHUM**, a German city in the state of Westphalia, 9 mi. east of Essen. Around it are centered the iron and steel and the coal industries of Westphalia, and it has large factories, foundries and coal mines. Bochum has municipally owned sewage and water supply systems and a municipal meat-packing house. Until the middle of the 19th century it was a country town of only 5,000 inhabitants. Pop. 1925, 211,249.

**BÖCKLIN, ARNOLD** (1827-1901), Swiss painter, was born at Basle, Oct. 16, 1827. He studied in several of the art centers of Europe, including Düsseldorf and Paris, but returned repeatedly to Italy

where he found the most congenial atmosphere. He resided in Florence from 1874-85, and again in 1892. Highly imaginative, he painted many mythological subjects and added to his landscapes a mystical quality that is his predominating characteristic. One of his most popular paintings, frequently reproduced, is *The Isle of the Blessed*, in the National Gallery, Berlin. Strikingly different in technique is the *Sea Idyll* in the Schack Gallery in Munich, notable for sunny light and color. Among his mythological paintings are *Pan in the Rushes* in the Munich Pinakothek, and the *Chase of Diana* in the museum of Basle. The artist died near Florence, Italy, Jan. 16, 1901.

**BODE, JOHANN ELERT** (1747-1826), German astronomer, was born at Hamburg, Jan. 19, 1747. In 1774 he established *Astronomisches Jahrbuch*, and compiled 51 of its yearly volumes. In 1786 he became director of the Berlin Observatory, holding this post until his retirement in 1825. Among his works are: *Sammlung astronomischer Tafeln*, 1776; *Erläuterung der Sternkunde*, 1776, 3rd ed. 1808; *Uranographia*, 1801; a collection of 20 star-maps; and a catalogue of many stars and nebulae. He also propounded a theory of solar constitution, and gave currency to the empirical rule known as "Bode's Law." Bode died in Berlin, Nov. 23, 1826.

**BODEGA** or **OLAMENTKE**, an American Indian group speaking a dialect of Moquelumnan (Miwok). They occupied territory north of the Golden Gate and San Francisco Bay, Calif.

**BODE'S LAW**, the name given to a curious progression in the distances of the planets from the sun, formerly thought to express a law of nature.

**BODLEY, SIR THOMAS** (1545-1613), English diplomat, scholar and founder of the Bodleian Library, born at Exeter, Mar. 2, 1545. He studied languages at Geneva and at Magdalen College, Oxford. Queen Elizabeth frequently sent him on missions to Denmark, France and Holland. His outstanding accomplishment was the restoration and extension from 1597-1602 of the university library at Oxford. In 1604 letters patent giving it Bodley's name were granted by James I. He died at Oxford, Jan. 28, 1613.

**BOE, LARS WILHELM** (1875- ), American educator, was born at Calumet, Mich., Dec. 27, 1875. He graduated at St. Olaf's College, Northfield, Minn., and after completing studies at the United Lutheran Church Seminary at Minneapolis, was ordained a minister. He was president of the Waldorf College, Forest City, Iowa, from 1904-15, during which time he was a member of the Iowa House of Representatives from 1909-11 and sat in the Senate from 1913-15. In Sept. 1918 he became president of St. Olaf's College.

**BOEHM VON BAWERK, EUGEN** (1851-1914), Austrian political economist, was born at Brunn, Feb. 12, 1851. He studied at Vienna, Heidelberg, Leipzig and Jena and in 1884 became professor at Innsbruck. In 1895, 1897-98 and 1900-04 he served as minister of finance. His studies on value and his views on the

theory of capital and interest attracted widespread attention, especially in the United States. He attacked the conventional understanding of interest, maintaining that it exists at contemporary levels chiefly because of man's incapacity to gauge his future needs. He wrote *Capital and Interest, The Positive Theory of Capital* and *Karl Marx and the Close of His System*. He died at Vienna, Aug. 28, 1914.

**BOEOTIA**, a district in ancient Greece between the Euboean Channel and the Gulf of Corinth. The Boeotians were proverbially known for their dullness. Their chief town was Thebes, which at one time was one of the most powerful cities in Greece.

**BOERHAAVE, HERMAN** (1668-1738), famous Dutch physician and one of the leaders in making Leyden a medical center in the seventeenth century, was born at Voorhout, Dec. 31, 1668. After a broad education, he undertook to teach chemistry, physics and botany, as well as medicine, and also wrote extensively in all of these fields. He was considered the greatest medical consultant of his time. He was the first to describe rupture of the esophagus and the premonitory symptoms of hydrophobia. He described various disturbances of the heart and used the thermometer in his clinic. His reputation as a physician extended throughout the known world. He was consulted by emperors and great men everywhere and his phenomenal success may be measured by the fact that he left at his death an estate estimated as worth 2,000,000 florins.

**BOERS.** The Boers (Dutch for farmers) are the descendants of Dutch settlers in South Africa, and live in the areas now comprising the Union of South Africa. The first Dutch settlement was established in 1652 under Jan van Riebeck at Table Bay. Governed by autocratic agents of the Dutch East Indies Company, surrounded by numerous and hostile negro tribes, and almost fanatically religious, the Boers developed a strong, tenacious, and obstinate character, as well as great love for tradition and custom. They were much dissatisfied with the British system of control as established in 1814 after the Congress of Vienna had confirmed England's possession of the Cape Colony which she had captured in 1795. In the 1830's, accordingly, the Boers commenced a *trek* northward which, lasting for almost a score of years, resulted in the successive founding of Natal, the Orange Free State, and the Transvaal or South African Republic. Eventually, however, England came into final possession of these regions also, Natal in 1843, and the other two states by the Treaty of Pretoria, May 31, 1902, closing the Boer War. Since Jan. 1, 1910 Cape Colony, Natal, Orange Free State, and the Transvaal have been united in the Union of South Africa, a strongly-centralized dominion. Most of the dominion premierships have been held by Boers despite the presence of many Englishmen in Cape Colony. The most distinguished Boer leader in the period of the World War and after was Gen. Jan Smuts.

See G. M. Theal, *History of South Africa from 1795 to 1872*, 5 vols., 1916.

**BOER WAR**, a struggle from 1899-1902 over the independence of the two South African republics, the Transvaal and the Orange Free State, between Great Britain on one side and the Boers or Dutch farmers on the other. After the seizure of the Cape of Good Hope in 1795 during the occupation of the Netherlands by the French there was constant friction between the Boers, as the Dutch farmers were called, and the colonial administration of England. In 1835 hundreds of Boers joined the Great Trek, to escape British dominion, and formed the Orange Free State north of the Orange River. Another group of Boers in 1838 settled in the Transvaal, northeast of the Free State, and in 1880 declared this area an independent republic. As Britain was not prepared to consider the Boers an autonomous people, friction increased. In 1895 a group of 600 Englishmen and English supporters led by Dr. Jameson, administrator of Rhodesia, massed on the Transvaal border, and made a raid into the Boer republic, avowedly on behalf of the *uitlanders*. Jameson was forced to surrender, and the Boers prepared for war. On Oct. 9, 1899, President Kruger of the Free State demanded that Britain remove all border troops. The ultimatum was unanswered, and the Boers opened hostilities, occupying Ladysmith in British Natal, which they overran. In November the original British force of 22,000 was augmented by an army corps of 54,000 from England, and reinforcements arrived in a steady stream. The Boers, however, were highly proficient at guerilla warfare; they were excellent marksmen, and fought fiercely for their right to independent rule. Thus the preponderance of military strength in Britain's favor did not discourage the Dutch in the first stages of the war. The British regained Ladysmith on Feb. 28, 1900. Mafeking, which the Boers had seized in Oct. 1899, was regained by the British on May 16, 1900, and shortly after Cronje, Boer general, surrendered at Paardeberg. By constructing a series of block-houses, Lord Kitchener extended and protected his advance lines, and slowly forced Kruger back toward Pretoria, in the Transvaal. Peace was signed May 31, 1902, Britain obtaining all of South Africa from Cape Town to the Zambesi.

The British lost about 23,900 men, killed, wounded, or missing, while the Boer casualties were 4,000 dead and 40,000 made prisoners.

**BOETHIUS, ANICIUS MANLIUS TORQUATUS SEVERINUS** (c. 480-524), Roman scholar and statesman, was born in Rome in 480. He was educated at Athens, and returning to Italy, was so noted as a scholar that Theodoric appointed him Consul in 510. Boethius was of independent character, and when the Consul, Albinus, was brought to trial for treasonous actions, he defended the accused with such vigour and magnanimity that he was thrown into prison himself. There he wrote his *De Consolatione Philosophiae*, a famous work translated by Alfred the Great and by Chaucer, among others. Boethius, the last of the Roman scholars, translated from the Greek, works of rhetoric, philosophy and

mathematics. In the Middle Ages his translations and commentaries on Aristotle were studied in the schools. Boethius was put to death in 524. Regarded as a martyr, he was canonized as Saint Severinus.

**BOG**, a name loosely applied in the United States to any wet, quaggy ground, swamp, or marsh. Its strict usage is confined to peat-bogs, rendered spongy by deep deposits of water-holding, decaying vegetation. True bogs are not uncommon in New England and the northwestern United States. They cover extensive areas in Great Britain. By "climbing bog" is meant a saturated peat-moss, developed about a hillside spring. Occasionally a great Irish bog bursts, after heavy rain, inundating cultivated lands, as at Killarney in 1896, when nine lives were lost.

**BOGALUSA**, a city in Washington Parish, southeastern Louisiana, situated near the Pearl River, 71 mi. north of New Orleans. The New Orleans Great Northern Railroad serves the city. The Forestry Camp of the University of Louisiana is located nearby. Bogalusa lies in a great pine timber region. The city is an important industrial center, having lumber, lumber products and paper mills, canneries and railroad shops. The retail trade in 1929 amounted to \$4,836,682. Bogalusa was incorporated in 1914. Pop. 1920, 8,245; 1930, 14,029.

**BOGIE**, a low railroad-car truck with four or more wheels. In railway parlance most commonly used to distinguish the four-wheeled, center-bearing truck from the two-wheeled or pony truck, both used as leading trucks of locomotives.

**BOGOTÁ**, the capital and largest city of Colombia, situated on a tableland 400 sq. mi. in area and 8,694 ft. above the sea. Separating the basins of the Magdalena and the Orinoco rivers, this plateau is bounded on all sides by mountains. It lies near the Equator, but has a temperate, salubrious climate, with a mean temperature of 60° F. due to its elevation. Situated about 600 mi. from the north coast and 210 mi. from the Pacific, Bogotá was at one time the most impregnable of South American cities. It has also been noted as a cultural center. The city is well laid out and covers a large area, as the homes are of only one or two stories with interior patios, or courts. Like most South American cities, it has large plazas, open squares usually with trees in the center, and public gardens. The capitol is an imposing building covering 2½ acres. Other handsome structures include the presidential palace, a public library, a museum, a cathedral and many churches.

Although there is considerable activity in the manufacture of flour, woolen and cotton goods, shoes, and other basic commodities the many aristocrats of Bogotá are at present chiefly interested in culture or politics. However, loans obtained in the United States are being spent on several municipal works, and the capital is becoming an important manufacturing center. Pop. 1928, 235,421.

**BOGOTA**, a borough of Bergen Co., N.J., located on the east side of the Hackensack River, facing Hackensack and 4 mi. west of the New Jersey ter-

minus of the George Washington Memorial Bridge. It is served by the New York, Susquehanna and Western and the West Shore railroads and motor bus and trolley lines. While mainly a residential suburb, it has several industrial establishments devoted to the manufacture of paper board. Pop. 1920, 3,906; 1930, 7,341.

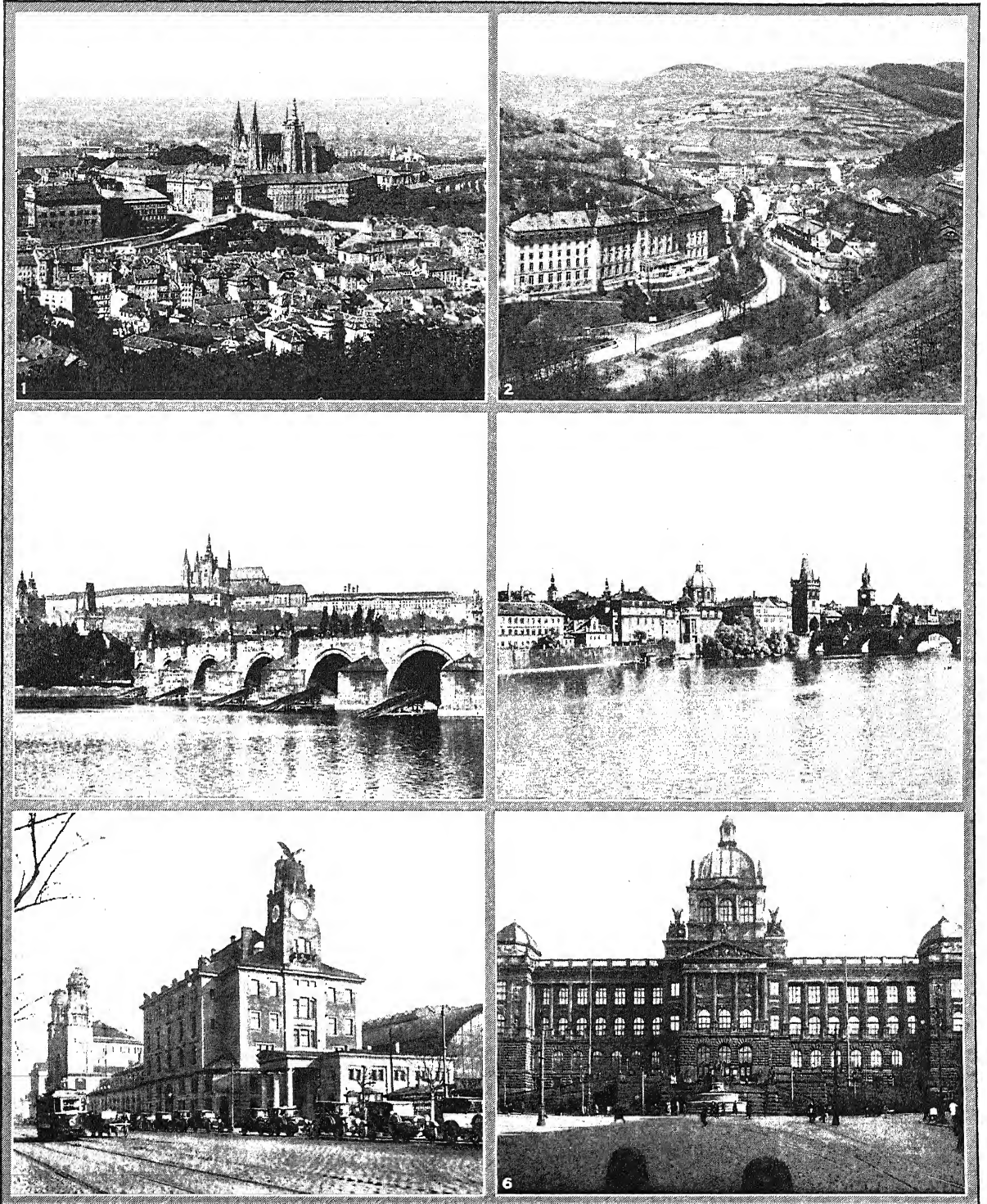
**BOHÈME, LA**, an opera in four acts by GIACOMO PUCCINI, libretto based on Henry Murger's novel, *La Vie de Bohème*, by Giuseppe Giacosa and Luigi Illica; première, Turin, 1896, London, 1897, New York, 1898. It has found rivals in popular favor only in *Tosca* and *Madama Butterfly* by the same composer.

The story is laid in Paris. Entranced by the free-and-easy life of the Latin Quarter, four young men, Marcel, a painter, Rudolph, a poet, Schaunard, a musician, and Colline, a philosopher, have settled there to pursue art and wisdom. Their chief difficulty is the landlord who demands rent at awkward moments. Into this scene of good-fellowship come two gentle students, Musette and Mimi. At length, continual poverty leads Mimi and Musette to seek the society of richer companions. Mimi is shortly abandoned by her wealthy suitor and with dramatic dispatch reaches the stage of tuberculosis and acute starvation. In this plight she is brought back by Musette to the student's garret; and although Colline, the philosopher, pawns his overcoat to buy the dying girl nourishment, she dies.

**BOHEMIA** (Czech *Cechy*), the chief province of the Czechoslovak Republic, bordering on Bavaria in the southwest, Saxony in the northwest, Prussia in the northeast, and Moravia and Austria in the southeast. Area 20,102 sq. mi. It is a rectangle surrounded by mountain ranges, the source of the Labe (Elbe) being in the Riesengebirge (Giant Mountains) near the northeastern frontier. The Labe drains practically all of Bohemia, its principal tributaries being the Vltava (Moldau) and the Ohře. In the northwest are the famous mineral springs, among them MARIENBAD, CARLSBAD and FRANZENSBAD. Education is widespread among both Czechs and Germans, the number of illiterates being extremely small. PRAHA has a Czech university, founded 1348, a German technical university, a German university, a technical and commercial university, art academies and a conservatory of music. Agriculture and stock raising are advanced, the climate and soil in the Labe valley being especially favorable. The large estates were broken up in 1919 to the advantage of the Czechish population. The extensive forests are well cared for by experts. Iron and brown coal are present and there is some graphite. The precious metals have been exhausted. Owing to its supply of raw materials and the industry and intelligence of the people, Bohemia is an important manufacturing country. Linen and wool weaving and the manufacture of glass are the leading industries. Lace, musical instruments and toys, beer, shoes, malt and sugar are important export articles. The largest cities are PLZEŇ and České. Pop. 1930, 7,107,766. See CZECHOSLOVAKIA, HISTORY OF.



# BOHEMIA



COURTESY CZECHOSLOVAKIAN CONSULATE-GENERAL

## VIEWS OF CZECH BOHEMIA

1. A view of Prague from the west bank of the Vltava, with the Cathedral of St. Vitus in center. 2. Jáchymov, a popular health resort in western Bohemia, near the Erzgebirge mountains. 3. The Charles Bridge over the Vltava.

The Hradčany, the fortified palace of old Bohemia, in the background. 4. A view of the Vltava. 5. The Woodrow Wilson Station in Prague. 6. The Czechoslovakian National Museum at Prague.



**BOHEMIAN GIRL, THE**, an opera in three acts by MICHAEL WILLIAM BALFE, libretto based on Fanny Ellser's ballet, *The Gipsy*, by Bunn; première, London, 1843, New York, 1844. Of Balfe's 31 operas virtually none but this attracted widespread favor; the exception, however, compensated in large measure for its companions, being for many years the most popular opera in the English language.

To escape arrest Thaddeus, an exiled Polish nobleman, joins a band of gipsies headed by Devilshoof. When he saves the life of Count Arnheim's infant daughter, Arline, Thaddeus is rewarded with a feast to which the gipsy band is also invited by the Pressburg governor; but when a toast to the emperor is proposed Thaddeus refuses to drink it. In the ensuing uproar Devilshoof is arrested for intervening in Thaddeus's behalf. Thaddeus later escapes, carrying away with him the youthful Arline. After a lapse of 12 years Thaddeus and Arline, the latter now grown to womanhood, are discovered to have married. They are living with the gipsy band while Arline has been given up for dead by her father. Florestan, Count Arnheim's nephew, has meanwhile been robbed of some jewels by Devilshoof. Through the jealous wiles of the gipsy queen who loves Thaddeus, these trinkets are pinned on Arline who, with the entire band, attends a fair held in Pressburg. Seeing the jewels, Florestan accuses Arline of theft, and in due course she is brought for sentence before her father. Recognition follows promptly, and a betrothal feast is arranged by the governor. An assassin's bullet aimed in vengeance at Thaddeus is diverted to the heart of the jealous gipsy queen, and the opera ends with her death.

**BOHEMIAN LITERATURE**, the literature of the Bohemians, treated under the heading CZECH LITERATURE.

**BOHR, NIELS** (1885- ), Danish physicist, was born at Copenhagen, Oct. 7, 1885. He studied under Sir J. J. Thomson at Cambridge and under Sir Ernest Rutherford at Manchester. He taught at Manchester in 1914, and in 1916 was appointed professor of theoretical physics at Copenhagen. Bohr followed out the theory that an atom consists of a small positively charged nucleus surrounded by negative electrons and combined with this Planck's equations of quanta of energy in radiation, postulating a series of stable states in an atom in which change from one to the other is accompanied by definite energy radiation or absorption. He applied his theories to the periodic table in an attempt to explain the periodicity of congruences, as the similarity of all the inert gases (see PERIODIC SYSTEM), designing an atom resembling the planetary system. Bohr's theories have been generally accepted and have led to much fruitful investigation. In 1922 he was awarded the Nobel Prize in physics, and was elected to membership in the Royal Society.

**BOHR'S THEORY.** See LINE SPECTRUM.

**BOIARDO, MATTEO MARIA, COUNT** (c. 1434-1494), Italian poet, was born at Scandiano, near Reggio di Medina, in 1434. He studied at the

University of Ferrara, obtaining the degrees of Doctor of Philosophy and of Law. In 1478 he was appointed Governor of Reggio, a post he held for many years. According to one ancient chronicler, however, he was "better fitted for writing verses than for punishing crimes." Boiardo's chief title to fame, the *Orlando Innamorato*, was written for the enjoyment and recreation of Duke Hercules d'Este and his court at Ferrara. It is the first important example of that type of romantic drama, and served as the prototype for Ariosto's *ORLANDO FURIOSO*. Boiardo also wrote comedies and minor poems. The poet died at Reggio, Dec. 20, 1494.

**BOIL**, or furuncle, a small, hard nodule on the skin, enclosing a mass of dead tissue and pus, caused by infection (usually staphylococcus) of tissue and sebaceous glands surrounding a follicle. It is accompanied by pain, inflammation, and throbbing. A pustular apex forms and breaks, emitting the core. The cavity heals rapidly, leaving a small white scar. Occasionally a boil is blind, in which case no head is formed and the core is absorbed. A boil is brought on by friction, derangements in diet, or favored by systemic conditions. If treated at an early stage with cold compresses, the development of a boil may be checked; otherwise hot poultices will be helpful in relieving the pain and drawing it to a head. A boil can sometimes be dangerous, and when severe, it is advisable to see a doctor. Vaccines have been efficacious in some cases.

**BOILEAU-DESPRÉAUX, NICOLAS** (1636-1711), French critic, was born in Paris, Nov. 1, 1636. He studied first for the priesthood, then for law, but devoted himself finally to literature. During 40 years he produced a vast number of works, the most important of which is *l'Art poétique*, 1674, which established an esthetic code for all forms of poetical composition. His *Le Lutrin*, 1673, and *Dialogue des héros de roman*, 1664, are satirical works. Boileau was great as a satirist, and, as a critic, led the way in simplifying French literary taste. He was made Royal Historiographer by Louis XIV, and received an annual pension. Boileau died in 1711 in Paris.

**BOILER CONSTRUCTION CODES.** Methods of construction and rules for designing BOILERS were not codified in an orderly manner until 1908, when a Massachusetts statute created a Board of Boiler Rules which formulated and enforced a construction code for steam boilers. In 1911 Ohio took the same action. In 1911 the American Society of Mechanical Engineers set up a committee to draft rules and regulations governing the materials, methods of calculation, and the character of workmanship to be used in the design and construction of steam boilers. This committee, popularly known as the Boiler Code Committee, made up of representatives of manufacturers, users and insurers of boilers, reported a complete code in 1915, which has since been generally accepted by engineers and manufacturers and has been made the legal standard of 19 states and 15 municipalities. In addition to the Power Boiler Code, the Committee

has also issued construction codes for locomotive boilers, miniature boilers, heating boilers operating at less than 15 pounds per square inch, and unfired, pressure vessels. Supplementary codes on the care of power boilers in service, and rules for inspection have also been prepared. As the science progresses alterations and additions to the requirements are made so that advancement and improvement are not hampered.

The several Codes may be obtained from the American Society of Mechanical Engineers. The U.S. Steamboat Inspection Service of the Department of the Interior has issued complete rules governing marine boilers. The British Board of Trade, Lloyd's Register of Shipping, Bureau Veritas and the American Bureau of Shipping have boiler construction Codes of legal or quasi legal standing. E. R. F.

**BOILER CORROSION**, the destructive action which feed water impurities exert upon the steel in steam **BOILERS**. Free acid and free alkali are both injurious to the boiler steel, the former causing direct dissolution, while the latter produces **CAUSTIC EMBRITTLEMENT**. The presence of various neutral salts, particularly chlorides, may also result in serious corrosion, as may the use of distilled water practically free from dissolved substances. The corrosive agent most generally present in water is the oxygen dissolved upon contact with the atmosphere. At the temperature of a boiler, the oxygen introduced with the feed water readily combines with the iron of the boiler. The chemical attack usually takes place at a number of individual points, producing "pitting," in which the iron may be completely penetrated at a few points long before the rest of the surface is seriously attacked.

Boiler corrosion, like other forms of corrosion, may be regarded as electro-chemical action in which two small areas of the boiler surface and the boiler water form a small **ELECTROLYTIC CELL**, one area of the metal being at a lower potential than the other as the result of the presence of impurities or of differences in the composition of the solution.

The most common means for the prevention of boiler corrosion is the removal of dissolved oxygen from feed-water by means of feed water heaters or de-aerators. Corrosion may be prevented, even with the worst water supplies, by chemical treatment under adequate control. See **FEED WATER TREATMENT**; **BOILER SCALE**. E. P. P.

**BOILER EFFICIENCY**, the ratio of the heat input, of a **BOILER** as supplied by the combustion of the fuel or contained in the hot gases from an industrial furnace or other source, to the heat output as delivered in the steam. The efficiency of operation of a boiler depends on many factors, the principal ones being: Completeness of combustion; Amount of excess air; Rate of heat absorption by the boiler and other heat absorbing accessories such as **ECONOMIZERS**, **SUPERHEATERS** and air heaters, if used; Tightness of setting against air infiltration; Radiation; and Freedom of absorbing surfaces from scale, soot, and the like. Efficiency as high as 92% has been recorded but 85% may be considered very satisfactory under

good conditions, and in the ordinary plant it will be on the order of 75% or lower. The accurate determination of boiler efficiency is a delicate and complicated operation requiring the services of trained engineers. The Test Code for Steam Generating Units, prepared by the Power Test Code Committee of the American Society of Mechanical Engineers, is the best guide for boiler testing. E. R. F.

**BOILER FURNACE OPERATION**, mainly the regulation of the fuel and air supply to a furnace according to the changing demand for steam. The process of burning fuels is a chemical combination of the combustible part of fuel with the oxygen of the air. The combustible part of all commercial fuels consists mainly of **CARBON** and **HYDROGEN**. One pound of carbon combines with 2.67 pounds of oxygen to form 3.67 pounds carbon dioxide,  $\text{CO}_2$ . One pound of hydrogen combines with 8 pounds of oxygen to form 9 pounds of water vapor,  $\text{H}_2\text{O}$ . Atmospheric air is approximately 20% oxygen. Therefore, the combustion of one pound of carbon requires about 13.5 pounds of air, and one pound of hydrogen about 40 pounds of air. With good furnace operation about 25% excess air is generally supplied to the furnace to obtain nearly complete combustion. The supply of air to the furnace is just as important as the supply of fuel, since too little means incomplete combustion and a waste of fuel and too much means more heat wasted in the gases passing out through the chimney.

Coal is the most common fuel for steam boilers. Fuel oil, natural gas and blast furnace gas are used only when they are available at a price that compare with the price of coal, or when they offer special advantages in handling, as does fuel oil on steamships.

Coal is burned in hand-fired furnaces, on mechanical stokers, and in pulverized form. Mechanical stokers supply coal and air to the furnace continuously at a rate which is controlled by the furnace operator or by automatic apparatus. In a hand-fired furnace charges of coal are thrown onto the grate at intervals varying from one to 20 minutes, depending upon the nature of the coal and the demand for steam. In both the stoker and the hand-fired furnaces the rate at which coal is burned depends upon the supply of air through the fuel bed and that is controlled by the intensity of the draft. Some air is supplied over the fire to burn the combustible gases rising from the fuel bed.

Pulverized coal, fuel oil and gas are supplied to the furnace continuously at a rate proportional to the demand for steam, and the air supply is proportional to the rate of fuel supply.

Devices automatically controlling fuel and air supply have been developed and installed in many of the modern boiler plants. In such plants the furnace operator's work is reduced to the supervision of these devices and recording instruments. H. K.; K. T.

**BOILERS**, a term covering an apparatus in which water is converted to steam through the agency of heat, usually applied externally. The term is here technologically restricted to those installations supplying steam for power or industrial uses.

The earliest boilers were hemispherical tanks designed for a pressure of about one pound per square inch. Until the beginning of the 18th century, development was slow, but early in the following century the cylindrical boiler was introduced and pressures were increased to 30 and 40 pounds per square inch. Stevens in 1804, Eve in 1825 and Wilcox in 1856 brought out the "water tube" boiler in which tubes carried the water through the fire and formed the greater part of the area through which heat was transmitted to the water. Toward the later part of the 19th century, development became more rapid, due to the introduction and enormous growth of electric POWER PLANTS and the increased use of steam in industry. This increased demand resulted in: The development of specialized apparatus, such as ECONOMIZERS, SUPER-HEATERS, STOKERS and the like, which are devices that more fully utilize the heat of the fuel or increase the economy of operation; the introduction of the MERCURY VAPOR BOILER and the utilization of the BINARY CYCLE in steam production; the invention of boilers of the Benson or "flash" type that exhibit very little resemblance to their prototype of earlier days.

It is customary to "rate" boiler sizes, as well as capacities, by the term "boiler horsepower," which is arbitrarily taken to mean ten square feet of heating surface. (See also STEAM GENERATORS.) A boiler having an area exposed to the fire of 5,000 square feet, is therefore a 500 horsepower boiler. Inasmuch as the capacity of a boiler is dependent on the kind and amount of fuel burned in its furnace, the actual capacity of a boiler nominally rated at 500 horsepower might well be 1,000. The boiler would be operating at 200% of its rating. As the use of turbo-generators has increased specifications have become more precise, and now a definite quantity of steam per hour is usually demanded at a definite pressure and temperature, with FEEDWATER at a given temperature.

The "fire tube" boiler is the exact opposite of the water tube type, the hot gases passing through tubes immersed in water, but it is seldom used in modern plants of any size. It is, however, still used for small installations under certain conditions. An important class of fire tube boilers is the "return-tubular" boiler which is so constructed that the hot gases pass from the furnace along the underneath side of the boiler shell to the rear of the unit and then return through the "fire tubes" to a stack at the front. Of the return-tubular boilers, the Scotch marine boiler is, perhaps, the best known and most widely used. It is internally fired, the furnace and the boiler proper being included in a common shell that forms the external wall of the boiler.

E. R. F.

**BOILER SCALE**, a crystalline deposit on BOILER surfaces, formed by the precipitation of fine solid particles dissolved in the boiler feed-water upon the evaporation of the water. Since substances such as calcium sulphate and calcium carbonate, which become less soluble with increase in temperature, are the most common constituents of boiler scale; and since

scale in general forms most rapidly on the boiler surfaces exposed to the most severe heat, it is supposed that scale deposition occurs because of the decreased solubility of the scale-forming substances in the region of higher temperature close to the heating surfaces. Scale is objectionable because it slows down the rate of transfer of heat from the furnace to the water, but more particularly because it results in the overheating of the boiler tubes, sometimes causing failure under pressure. Its formation may be prevented by chemical treatment to precipitate the scale-forming substances from the feed-water before it enters the boiler, or to control the precipitation within the boiler so that only substances with a very slow rate of scale formation will be deposited. See FEED-WATER TREATMENT; BOILER CORROSION.

E. P. P.

**BOILING POINT**, the temperature at which the saturated vapor pressure (see VAPORIZATION) of a liquid is equal to standard atmospheric pressure, or 760 mm. of mercury. If the pressure to which the liquid is subjected is less than 760 mm., the boiling point is lowered, and vice versa. At temperatures close to 100° C. a change of 27 mm. in the pressure produces a change of 1° C. in the boiling point of water. On high mountains, the atmospheric pressure is so low that the boiling point of water is lowered several degrees, and many cooking operations require much longer than they do near sea level. The efficiency of pressure cookers is due to the fact that the boiling temperature is raised several degrees above 100° C.

W. W. S.

**BOIS DE BOULOGNE**, the most famous park of Paris, a beautiful oak forest, about 2,200 acres in area, lying along the western border of the city, near the Place de l'Étoile. It was made into a park in 1853 and has since remained the favorite Parisian resort. The Longchamps races and the Auteuil steeplechases are held here. The suburbs of Neuilly and Suresnes adjoin the Bois.

**BOISE**, the capital of Idaho and the county seat of Ada Co., situated in the southwestern part of the state, on the Boise River, about 450 mi. from Portland, Spokane and Salt Lake. The city is served by the Union Pacific Railroad and a municipal airport. The Boise valley produces hay, grain, honey and fruit and there are extensive sheep raising and dairying interests. Among the manufactures are candy, building stone, lumber and iron products. In 1929 the factory output reached approximately \$3,000,000; the retail trade amounted to \$20,040,513. A natatorium supplied with hot water from a boiling, flowing well is located at Boise. The city occupies the former site of a trading post of the Hudson Bay Fur Company, which was founded before 1863. In 1865 Boise was granted a city charter. Pop. 1920, 21,393; 1930, 21,544.

**BOÏTO, ARRIGO** (1842-1918), Italian music composer and librettist, was born at Padua, Feb. 24, 1842. He studied at the Milan Conservatory. His opera *Mefistofele*, produced in 1865, was at first a failure. It is historically significant, however, as the



model which changed Italian opera from mere coloratura exhibition to the more serious dramatic style illustrated in the compositions of VERDI and PUCCINI. He excelled as a librettist and wrote the books for Verdi's *Otello* and *Falsstaff*, and for Ponchielli's *La Gioconda*. He died at Milan, June 10, 1918.

**BOJER, JOHAN** (1872- ), Norwegian writer, was born at Trondhjem in 1872, and educated in the Trondhjem Military School and later in Paris, Italy, Berlin and London. He has written plays, novels and short stories, many of which have been published in French and English. Among Bojer's publications are *Helga*, *A Procession*, *Life*, *The Eyes of Love*, *The Great Hunger*, *The Prisoner Who Sang*, 1924, *The Emigrants*, 1926, and *The New Temple*, 1928.

**BOK, EDWARD WILLIAM** (1863-1930), American editor, was born at Helder, Netherlands, Oct. 9, 1863. He was brought to America when a child, and educated in the Brooklyn, N.Y., public schools. He entered the business world as a stenographer, but at 19 was editing *The Brooklyn Magazine*. In 1886 he organized the Bok Syndicate Press which he managed until 1891. He was editor of *The Ladies' Home Journal* from 1889 to 1919, and vice-president of the Curtis Publishing Co., Philadelphia, until his death. In 1923 he created the \$100,000 American Peace Reward. He wrote *The Young Man in Business*, 1895, *Successward*, 1895, and *The Americanization of Edward Bok*, 1920. He died at Lake Wales, Fla., Jan. 9, 1930.

**BOKER, GEORGE HENRY** (1823-90), American writer, was born in Philadelphia, Pa., in 1823, and graduated at Princeton in 1842. He wrote several dramas of which *Francesca da Rimini* was the most successful. During the Civil War he was inspired to write patriotic poetry and published *Poems of War and Street Lyrics*. In 1871 he became Minister to Turkey and in 1875-79 was Minister to Russia. Boker died in Philadelphia, Jan. 2, 1890.

**BOKHARA** or **BUKHARA**, formerly a Turkish province, later the name of a town and province of the R.S.F.S.R., now properly Staro-Bokhara or Kazan, a trade and manufacturing center in the western part of the Uzbek Soviet Socialist Republic. It is built around an oasis near the Zeravshan River. The town is roughly identical with the ancient Old Bokhara or "Bokhara the Noble," so named because of its intellectual renown in Islam culture. Old Bokhara is 8 mi. distant from Staro-Bokhara. It is not to be confused with the former province of Russian Turkestan of which SAMARKAND was the capital. The chief products of the old city are silks, copperware, rugs and a variety of Oriental merchandise; there is a considerable export trade in books, cotton, raw materials, dried fruits and hides. Staro-Bokhara, which has connections with the Transcaspian Railway, contains cotton mills and an oil refinery. Est. pop. 1926, 78,000; pop. Old Bokhara, 1926, 46,706.

**BOK SINGING TOWER**, a carillon tower at Mountain Lake, Fla., designed by Milton B. Medary and erected by Edward W. Bok as a gift to the Amer-

ican people. In beauty of architecture it is compared with the TAJ MAHAL. The tower rises 205 ft. from a base 50 ft. wide and is surrounded by a moat. The base and buttresses are of mottled gray Georgia marble and the top is shell pink Etowah stone. The ashlar is salmon pink coquina rock. At the top are eight great bell windows with elaborately carved polychrome grilles executed by Lee Lawrie. The carillon of 61 bells is one of the largest in the world.

**BOLAN PASS**, a strategically important pass on the frontier of Baluchistan near the city of Quetta and close to the Pishin Valley. Quetta has become an advanced British military station at a vital point on the southernmost route from India to Afghanistan, and about midway between Shirkarpur and Kandahar. The control of the pass secures the Pishin Valley, holds all the unruly Mari, Bugti and other border tribes in check, keeps open the roads of the Khojak and Gwaja passes over the Khoja Amran range, and thus facilitates rapid advance to Kandahar.

**BOLDO** (*Peumus Boldus*), a small evergreen tree of the monimia family native to Chile. It grows about 20 ft. high bearing very rough leathery leaves, white flowers in small clusters, and sweet, aromatic, edible berries. The exceedingly hard wood is used for manufacturing various implements and makes a fine charcoal; the leaves are employed medicinally as a tonic and antispasmodic.

**BOLERO**, a Spanish dance known also as a *cachucha*. It is in lively tempo and triple meter, having a variety of rhythms of which the following may be taken as representative:



**BOLETUS**, a numerous genus of tube-bearing fungi differing from the common mushroom chiefly in having on the under side of the cap a honey-combed fruiting surface instead of flattened gills. There are about 100 species, widely distributed throughout the world, some of which, as the edible boletus (*B. edulis*), are used for food though others are poisonous. In many species the flesh, usually white or yellowish, turns blue immediately upon being cut open and exposed to the air; such species are inedible.

**BOLEYN, ANNE** (1507-36), Queen of England and second wife of Henry VIII, was born in 1507. With her father, who was ambassador to France, she visited the court of Louis XII, where she remained in the retinue of Queen Claude until 1522 when she returned to England as maid of honor to Catherine of Aragon, the wife of Henry VIII. In 1531 Henry separated from Catherine, and in 1533 married Anne, securing the nullification of his marriage with Catherine from the English clergy. In the same year Elizabeth was born, and Anne's domestic troubles began. She produced no son for Henry, made numerous enemies and finally was accused of adultery. In the trial which followed in May 1536, she was condemned to

death, and on May 19, 1536, she was beheaded on Tower Green.

**BOLINGBROKE, HENRY ST. JOHN, VISCOUNT** (1678-1751), English statesman, orator and writer. Entering Parliament as a Tory in 1701, he distinguished himself by his eloquence. He was entrusted with important offices and was the leader of the Tory party. In 1713 he was England's representative in the negotiations of the Treaty of Utrecht. Because of his membership in the Jacobite faction, Bolingbroke fled to France upon the accession of GEORGE I. The remainder of his life he spent in political intrigues and attacks on his political enemies through periodicals and pamphlets. He died on Dec. 12, 1751.

**BOLIVAR, SIMON** (1783-1830), South American "Liberator" and statesman, was born in Caracas, Venezuela, July 24, 1783, of an aristocratic family. In 1799 he sailed to Spain to complete his education and in May 1802, he married Dona Maria Teresa del Toro, in Madrid. She died the next year in Venezuela—a bitter blow to Bolivar, who never married again. In 1804 he witnessed Napoleon's coronation in Paris and in 1805 he took a solemn oath on Monte Sacro in Italy, where he was traveling in the companionship of Simon Rodriguez, a tutor and friend. Bolivar swore then that he would never rest until he had freed his compatriots from the hold of Spain. In the next year he returned to Venezuela after having visited several cities in the United States. In 1810 he sailed with Andrés Bello to London on a diplomatic mission for the revolutionary *Junta* of Caracas. There he met Francisco de Miranda, precursor of Latin-American independence. Shortly afterwards they returned to Venezuela, Bolivar serving as an officer under Miranda, who became the head of the revolutionary movement of Venezuela. When Miranda capitulated to a Spanish general, Bolivar was involved in his betrayal and later fled to Cartagena where he issued one of his famous manifestoes. Early in 1813 he cleared the lower Magdalena valley of Royalists, and then turned eastward to redeem Venezuela. His war with the Spaniards became a "War to the Death" in June of 1813 and for this he was much criticized. He defended himself, but later on in his career suspended the ruthless slaughter imposed by such a program. In August 1813, he was able to enter Caracas triumphant and was acclaimed "Liberator of Venezuela." Bolivar as a soldier won the admiration of people and aristocrats alike and was showered with eulogistic titles and honors.

After the restoration of Ferdinand VII of Spain in 1814 the tide turned against Bolivar and his arms and he was forced to flee again, going first to Curaçao, then to New Granada where he defeated the "unitary" republic of Cundinamarca and installed the Federalist Party. On May 8, 1815, he resigned and retired to Jamaica where he wrote the famous letter in which he showed himself a realistic and keen observer thoroughly cognizant of the obstacles he had to overcome. These were not only the Spanish

troops but the ignorance and backwardness of his own people. In 1816, from a base on the Orinoco, where he was joined by José Antonio de Paez and his picturesque "centaurs," the *llaneros* or cowboys of Venezuela, once his bitter enemies, he resumed the war against the royalists and was successful to the extent that he was able to call the celebrated Congress of Angostura on Feb. 15, 1818. In August of the same year he defeated the Spaniards at Boyaca, after a terrifically trying expedition across the Andes, and on Dec. 17 the creation of the Republic of Gran Colombia, composed of New Granada and Venezuela, was proclaimed. The second battle of Carabobo on June 24, 1821, definitely sealed the independence of Venezuela and in this year a constitution for the Republic of Gran Colombia was promulgated, embodying many of the political ideas of Bolivar, who was elected president. Believing that Ecuador should belong to the Republic of Gran Colombia, he now turned his attention to assisting the inhabitants of Quito (Ecuador) in their struggle and in May, 1822, his associate, José Antonio de Sucre, won the battle of Pichincha which freed them from Spanish rule and enabled them to become members of the Republic of Gran Colombia.

On July 26 and 27 of 1822 there took place the famous "interview of Guayaquil" between José de San Martín, the Argentine liberator of Chile and Peru, and Bolivar. Exactly what occurred no one knows, but San Martín left Peru and gave up his public career and to Bolivar was given the task and glory of ending the struggle. Bolivar proceeded to Peru where, with the aid of Sucre, in 1824 in the decisive battles of Junin and Ayacucho, he defeated and captured the last of the Spanish viceroys. In 1825 in Upper Peru (Bolivia) Gen. Sucre completed the rout of the Spaniards. Bolivar achieved thus the undying fame of having freed five nations from Spanish rule. He improvised troops where there were none, took them over almost insuperable mountains, and led them to victory against veteran forces. His personal magnetism and his great ability as a soldier account for the successes of the most distinguished period of his life.

From 1825 on Bolivar's star began to set. As a peace-time statesman he proved how difficult was the task of organizing stable governments. The constitution he framed in 1826 for the Upper Peruvians, who had named their republic Bolivia in his honor, epitomizes more than any other document his political beliefs. A president for life, four chambers and complicated electoral and administrative systems were presumably devised to conform to the ethnic, social, political and economic conditions of the Bolivians, but this constitution soon proved to be impracticable. Bolivar's dream of a great Spanish-American confederation also failed. He called the Congress of Panama of 1826 but only four nations attended and the results were inconclusive. Soon after, dissensions broke out in Gran Colombia and it was evident that the absence of Bolivar and the impracticability of his

ideas were contributing to the disintegration of the republic.

In 1826 he returned to Colombia and early in 1827 went on to Caracas after an absence of five years to stem a revolt. In April 1828, he called the Convention of Ocaña to consider reforms of the constitution and there Francisco de Santander, a vice-president and a recent convert to federalism, opposed Bolivar and was accused of complicity in an attempt on the life of the Liberator. Though Bolivar was again proclaimed Dictator the Republic was breaking up. In 1830 he opened the Congress and resigned the presidency. Colombia, Venezuela and Ecuador separated, forming independent nations. Bolivar, weary, ill, impoverished, and bitterly disappointed, made his way to Santa Marta, Colombia, where he passed away on Dec. 17, 1830, attended only by a few acquaintances. He died believing, according to his own phrase, that he had "plowed the sea." He accounted all his great and lasting work for naught. To-day he is considered the greatest of all Latin-American heroes, and the centenary of his death was celebrated appropriately throughout all America. P. V. S.

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**BOLIVIA**, an inland republic of South America, bounded by Brazil on the north and east, Argentina on the south, Paraguay on the east and Peru and Chile on the west. As the outcome of the war with Chile (1879-83), Bolivia lost its short strip of coast land. Area 506,467 sq. mi., subject to revision on settlement of a boundary dispute. Sucre is the capital; LA PAZ the actual seat of government. Est. pop. 1930, 2,972,600.

**Surface Features.** The country has two major geographical regions each of which has distinct subdivisions. About two-fifths of the area is made up of the lofty ranges of the Andes and the plateaus that lie between them, and about three-fifths consists of tropical plains, difficult to reach from either ocean. The peaks of the Bolivian Andes attain heights of 20,000 to 24,000 ft. and are perpetually snowcapped although they are within the tropics; the lowest passes are from 12,000 to 14,000 ft. above sea level. Nowhere else does a nation with cities, railways and modern industries exist at such an altitude. East of the Andes lie the great tropical plains which make up 60% of the total area of the country. In part, these are densely forested, but toward the southeast the forests give place to the scrub and grass lands of the Bolivian *Chaco*. Through these eastern plains flow large and partially navigable rivers that reach the rivers Amazon and Paraguay. A large part of the contact of eastern Bolivia with the outer world is by way of these rivers which flow to the Atlantic.

**Inhabitants.** Of the population, more than half are full-blood Indians; a small fraction, probably less than 8%, are unmixed white; the remainder are mestizos, or *cholos*, the mixture of Spaniards and Indians. There is scarcely any Negro blood in Bolivia. In the region above La Paz live the Aymarás, descendants of a subject race of the Inca Empire. Much more numerous are the Quechuas, the most important group of the Inca empire, now forming the chief element in the highland population from Ecuador to northern Argentina.

**Climate.** As in the other Andean regions, the climates are determined far more by elevations than by latitude; they are disposed vertically rather than horizontally. Thus, whatever the distance from the Equator, the mean annual temperature, which in the Yungas zone stands at about 75° F. up to 2,000 ft., falls to 66° on the plateau at 8,000 ft. and to 50° at La Paz and on the central tableland, 12,000 to 12,500 ft. Higher up, the slopes and crests penetrate into an arctic region which is uninhabitable. The northern plateau and the eastern tableland have a limited rainfall. The country around La Paz has about 21 in. annually.

**Fauna.** On the lofty plateaus are the llama, alpaca, vicuna, guanaco, chinchilla and viscacha. In the *montana* (the country on the eastern slope of the Andes, usually called the *montana*, is named the Yungas in the region east of La Paz) are the capybara, the peccary, tapir and many other useful animals. Almost all varieties of South American birds are found in the woodlands and on the uplands, among them some beautiful varieties of the humming bird, an indigenous species of stork, locally called *bata*, and the condor, eagle and vulture.

**Agriculture.** All of the agriculture is carried on by the Indians, either for themselves, or as tenants on large estates. Modern implements, except the plow, are practically unknown. The rigorous climate of the *Altiplano* restricts agriculture to the cultivation of potatoes, barley and the cereal called *quinua*.

Probably one million head of cattle graze on the northern plains; they consist of the creole breeds and *ganado bravo*, or wild cattle, which run for cover when pursued. Many handicaps restrict any major development of the grazing industry. Periodical inundations cover wide expanses on which the herds graze. Lacking salt, the region must import it at great expense by mule-pack and boat from the arid regions to the west. Hoof and mouth disease are endemic. There is no selection of breeding stock; fenced ranges are unknown.

**Forest Industries.** Despite the great wealth of hard and soft woods the lumber resources have scarcely been touched. High freight rates, owing to meager transport facilities, have prevented the development of even a Brazil-nut gathering industry. As yet the forests have been exploited only for rubber. Before the World War this constituted 24% of the value of the total export trade, whereas in recent years it has contributed a bare 3%.



# BOLIVIA

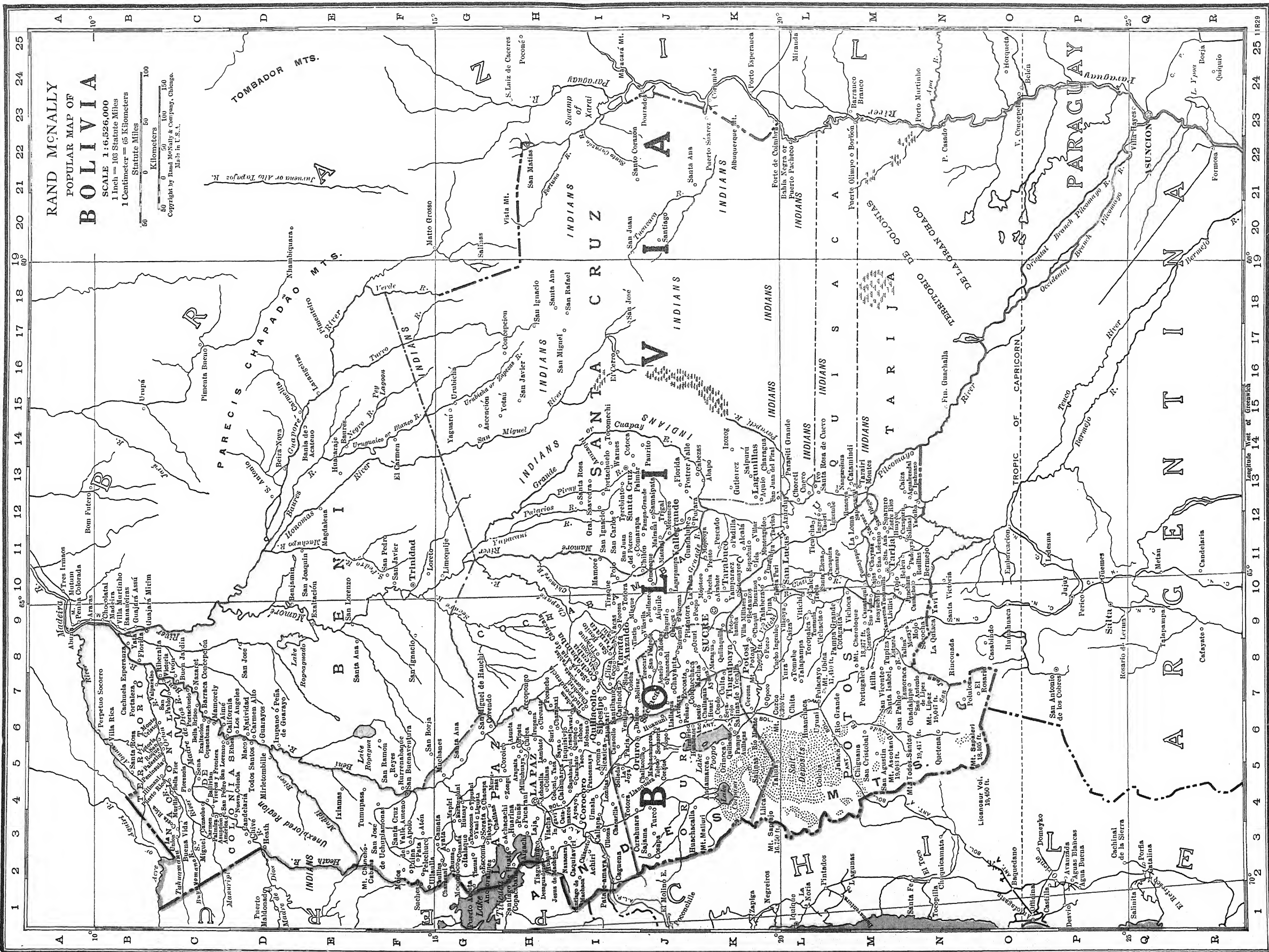
Area 514,464 sq.m.  
Pop. .... 2,972,583

## PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)

### Pop.—Thousands

6	Acacio	108
6	Achacachi	113
7	Achiri	113
7	Aigachi	113
6	Aiquile	113
9	Ancoraimas	113
11	Anzaldo	113
5	Arañi	113
6	Aromas Sica-	113
5	Ascención	113
5	Ayacucho	113
5	Ayoaño	113
6	Azurduey	113
6	Betanzos	113
6	Calza	113
6	Calamarca	113
6	Calcha	113
6	Callapa	113
6	Capinota	113
6	Caquiaviri	113
6	Caracolla	113
6	Challapata	113
6	Chayanta	113
6	Cliza	113
6	Cochabamba	113
6	Colomi	113
6	Colquechaca	113
6	Comarapa	113
6	Concepción	113
6	Copacabana	113
6	Corque	113
6	Cotagaita	113
6	Escoma	113
6	Huanchaca	113
6	Huachu	113
6	Huarina	113
6	Independencia	113
6	Itaque	113
6	Lagunillas	113
6	Laja	113
6	La Paz	113
6	Macha	113
6	Mocomoco	113
6	Morachata	113
6	Oruro	113
6	Padilla	113
6	Paria	113
6	Peñas	113
6	Pescado	113
6	Pitator	113
6	Pojó	113
6	Portachuelo	113
6	Potosí	113
6	Pucará	113
6	Punata	113
6	Quillacollo	113
6	Ribera	113
6	Sacaba	113
6	Sacaca	113
6	Salinas	113
6	Yocalla	113
6	Samaipata	113
6	San Benito	113
6	San Lucas	113
6	Sta. Ana	113
6	Calacala	113
6	Sta. Cruz	113
6	Santiago	113
6	Haute	113
6	Santibanez	113
6	Sipesipe	113
6	Sucre	113
6	Talavera	113
6	Puna	113
6	Talina	113
6	Tapacari	113
6	Tapacub	113
6	Tarata	113
6	Tarija	113
6	Tarvita	113
6	Tiaguana	113
6	Tingupaya	113
6	Tintin	113
6	Tiraque	113
6	Toco	113
6	Tomabe	113
6	Toropaca	113
6	Totor	113
6	Trinidad	113
6	Tupiza	113
6	Umal	113
6	Uyuni	113
6	Vacas	113
6	Vallegrande	113
6	Villavila	113
6	Yitchi	113
6	Warnes	113







Predominantly a forested country, Bolivia has a great variety of trees. Two major groups may be distinguished; the lower parts of the land, subject to floods, grow much bamboo, palms, soft woods and hard woods including the *ceiba*, whose crown towers above other trees. On the *tierra firma*, higher and fairly well-drained soils, are the Brazil-nut tree (*Bertholletia excelsa*), Spanish *cedro*, the rubber tree (*Hevea brasiliensis*), and many others.

**Mining.** Mining is the chief industry of Bolivia, although beset with extreme difficulties. On the four railways reaching the plateau, transportation is slow and expensive, since the lines must climb extreme heights in crossing the Andes and depend upon imported fuel and supplies. Mines which lie at considerable distances from rail transportation depend chiefly upon mule teams and pack trains of llamas or burros. The plateau and the mountain country yield neither coal nor oil. Labor consists almost entirely of Indians and *cholos* adapted to the regions and to living conditions of the mines at elevations of from 13,000 to 18,000 ft. This native labor, although fairly cheap, has a low efficiency and is not sufficient to meet the demands. Although the total output of tin did not reach 5,000 tons in 1897, today Bolivian mines account for almost one-fourth of the world's production. It is produced for export only, none being utilized in the country. The mineral moves chiefly in the form of tin concentrates, or *barilla*, which average from 55 to 70% tin. Silver, long the chief basis of the mining industry, was replaced by tin soon after 1900. However, silver still accounts for almost 10% of Bolivia's exports. Copper is largely a development of the 20th century; particularly of the World War when the demand reached great heights and when the Arica-La Paz Railway, which taps the chief copper district, was constructed. Lead, zinc, gold, antimony and tungsten are also mined; but the above-mentioned handicaps all tend to retard the mining of any but very rich ores, or less rich ores at times of high prices. Most of the world's supply of bismuth comes from Bolivia, where it is nearly all produced by a single company.

#### HISTORY

The Indian inhabitants of Bolivia were conquered in 1538 by Hernando Pizarro, brother and lieutenant of FRANCISCO PIZARRO, the famous conqueror of Peru. At Chuquisaca, Potosi, La Paz and elsewhere Spanish settlements were established in the middle of the 16th century. The region was governed by an *audiencia* under the name of Charcas, and attached to the viceroyalty of Peru until 1776, when it was transferred to the viceroyalty of Buenos Aires. An insurrection headed by Tupac Amaru in 1780 was the most formidable of several native uprisings. The first critical outbreak against Spanish rule at Chuquisaca in May 1809, was vigorously suppressed, and the country remained quiescent until on Dec. 9, 1824, the revolutionary army under Gen. Antonio José de Sucre overwhelmingly defeated the Spanish forces at Aya-

cucho in Peru. An extraordinary congress at Chuquisaca declared Charcas independent, on Aug. 6, 1825, and proceeded to change the name of the capital city to Sucre and the name of the republic, in compliment to SIMON BOLIVAR, to Bolivia. Gen. Sucre was the first acting president. Bolivar for a short period was titular chief executive of the new republic, and prepared its constitution, which provided for a centralized government with a tricameral congress and other complex devices. This document was supplanted in 1831 by one which followed the model of the United States, and which prohibited slavery.

Andrés Santa Cruz, called to the presidency in 1829, seven years later took advantage of Peruvian factional disputes to create the *Confederacion Peru-Boliviana*, with himself as supreme protector. In 1839 the confederation was broken up by Chilean troops. Bolivia then underwent 40 years of frequent insurrections, abbreviated presidential tenures, and rapidly revised constitutions. The prolonged dispute with Chile over possession of the nitrate deposits of the Atacama desert entailed Bolivia in the War of the Pacific with Chile, 1879-84, and remained a dominant issue in Bolivian foreign relations until well into the 20th century. Protests to the League of Nations, and to the United States Government when it acted as mediator in the controversy between Chile and Peru, that the treaty of 1904 whereby Bolivia completely surrendered its title to the Atacama district to Chile (in return for which Chile undertook to build a railroad, completed in 1913, from Arica to La Paz to provide Bolivia with an outlet to the Pacific), was signed under pressure, were ineffectual. Boundary disputes with Argentina were adjusted by treaty in 1889, and with Brazil in 1903 and 1909; a dispute with Paraguay remained unsettled in 1931. Unstable fiscal conditions and an attempt by President Hernando Siles to prolong his constitutional term of office resulted in a successful revolution in June 1930.

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**BOLLANDISTS**, a name applied to a group of members of the Society of Jesus in Belgium, engaged in publishing the lives of the saints. The originator of the work was John Van Bolland, S.J., who, in the 17th century undertook to carry out the plan of Fr. Rosweyde (d. 1629), to publish scholarly biographies of the saints. Publication of the *Acta Sanctorum* began at Antwerp, in 1643, and continued till some years after the suppression of the Society of Jesus, in 1773. After a gap of almost half a century the Bollandists resumed their work at Brussels, in 1837. In 1905 they were established in a splendidly equipped library in the College of Saint-Michel. The volumes of the *Acta Sanctorum* are far from uniform in value; in the *Analeccta Bollandiana*, initiated in 1882, and the *Bulletin des publications hagiographiques*, published since 1892, the Bollandists are issuing studies marked by critical scholarship of the highest type.

**BOLL-WORM.** See COTTON BOLL-WORM.

**BOLO**, a long-bladed, heavy cutting knife used in Malay and Caribbean countries, both for agricultural purposes and for combat. Such weapons were used against American troops in the Philippine Islands during insurrections. The natives, hiding in the long tropical grass, were able to cut down isolated soldiers.

**BOLOGNA**, a city of northern Italy, capital of the province of the same name, is a principal railroad junction, a modern industrial center and the location of the UNIVERSITY OF BOLOGNA. It is situated at the base of the Apennine Mountains. Jutting from the city's skyline are the great leaning towers of Bologna, the Torre Asinelli and the Torre Garisenda, survivors of 200 medieval watchtowers. The Cathedral of San Petronio is the largest church of the city; it is a Gothic structure begun in 1388 to honor Petronius, 5th century Bishop of Bologna. Notable also are the Seven Churches of San Stefano, San Giacomo and the 13th century San Domenico. In the latter are the tombs of St. Domenic, founder of the Friars Preachers, and of the painter Guido Reni. In the Accademia di Belle Arti is gathered a great part of the output of the BOLOGNESE SCHOOL OF PAINTING, but the highlight of the collection is Raphael's *St. Cecilia*. Flints, bones and implements testify to the habitation of Bolognese territory in prehistoric ages. Bologna was the *Felsina* of the Etruscans; it was conquered by Celts who renamed it *Bononia*, and as a Roman colony it was rich in baths, public squares and arenas. In 1122 Emperor Henry V made Bologna a free town. It possesses a noted sanatorium for the cure of rachitis. The numerous manufactures include cordage, ceramics, silverware and jewelry, and meal and alimentary pastes. Bologna is also an important trading center for hemp. Pop. 1931, 246,280.

**BOLOGNA, UNIVERSITY OF**, at Bologna, Italy, one of the oldest European universities and in medieval times one of the most renowned. It developed out of the student guilds of the city, famous for their teaching of jurisprudence as early as the 11th century. It was not constituted as a university, however, till late in the 12th century, and did not receive its first statutes till 1317. Throughout Europe the university's law school was known, and from every quarter it attracted students. The number of students at Bologna often exceeded 10,000; yet the university had no distinct building of its own until 1562, its lectures being given in the professors' homes or in hired rooms. The present university, which since 1803 has occupied rooms in the Palazzo Poggi, 16th century, enrolls about 1,500 students annually. In 1930 the rector was Giuseppe Albini.

**BOLOGNESE SCHOOL OF PAINTING**, an eclectic school of Italian art founded about 1585 by the CARRACCI brothers of Bologna, Annibale, Agostino and Lodovico. It was a principle with these three painters to draw direct from the nude model, chiefly for the religious purpose of achieving through naturalism a more poignant effect upon the emotions of the beholders. Young artists were also instructed to

study and take the best from the masters of Rome, Venice, Florence and Lombardy in drawing, color and style. Students came from every side, deserting the academy previously set up by Denis Calvaet of Antwerp. Among them were Guido Reni, Albani, Domenichino, Guercino, Tiarini, Cesi, Spada and Gatti.

In the late 15th century there was a close connection between the art of Bologna and Ferrara. Artists from one city were attracted to the other according to the power and art patronage of the ruling houses. Among the celebrated artists of the earlier Bolognese School were Francia, Francesco del Cossa and Lorenzo Costa.

**BOLOMETER**, an instrument for measuring RADIATION. It consists essentially of a thin, narrow strip of blackened platinum connected as one arm of a WHEATSTONE BRIDGE. The corresponding arm is an identical platinum strip which is shielded carefully. Radiation falling on the unshielded strip is absorbed. This raises the temperature of the strip and increases its resistance. This change in resistance, indicated by the Wheatstone bridge, is a measure of the energy absorbed. Bolometers are so sensitive that they respond to a change of one-millionth of a degree centigrade.

**BOLSHEVISM**, a particular interpretation of Marxian Socialism (see MARX, KARL) developed by a group of Russian Revolutionaries, particularly by V. I. Lenin, which holds that the seizure of power by the proletariat need not await the development of a highly organized industrial society, nor need it await a constitutional majority. It may on the contrary be effected at a propitious moment through the armed insurrection of a comparatively small minority who, having established a dictatorship of the proletariat, shall use their power both to combat the *bourgeoisie* and to accelerate the socialization of the economic life of the country. The November Revolution in Russia was a Bolshevik revolution, which actually established a dictatorship of the proletariat. From that day to this the major objective of the de facto Russian government (see DE FACTO GOVERNMENT) has been the complete socialization of the country. See also SOCIALISM.

**BOLTON ABBEY**, a village and parish situated in the West Riding of Yorkshire, England, 22 mi. northwest of Leeds, famous for its ruined priory or abbey, after which it is named. The abbey was founded originally for Augustinian canons at Embay in 1120 by William de Meschines and his wife, Cicely de Romili, and was transferred to the present site in 1151. The ruins, though not extensive, are very beautiful, and especially noteworthy is the nave of the former church, in the Early English and Decorated styles, which now serves as the parish church. Since the Reformation, the manor of Bolton Abbey has been a possession of the dukes of Devonshire or their ancestors. Pop. 1931, 250.

**BOLTRAFFIO, GIOVANNI ANTONIO** (1467-1516), Italian painter of the Lombard School, also known as Beltraffio, was born at Milan, of a noble family, in 1467. He painted only as an amateur and

his rare works show the influence of Leonardi da Vinci, with whom he studied. His color is, however, brighter and his contrasts of light and shade more vigorous than his master's. Boltraffio worked at Bologna in 1500 and visited Rome in 1513. He executed frescoes and portraits, and the Gallery Ambrosiana, Milan, possesses a collection of his drawings. *The Madonna of the Casio Family*, painted 1500, is in the Louvre, Paris; *St. Barbara* is in Berlin; and his *Madonna and Child* hangs in the National Gallery, London. Boltraffio died at Milan, June 15, 1516.

**BOLTZMANN, LUDWIG** (1844-1906), Austrian physicist, was born at Vienna, Feb. 20, 1844. He was successively professor of physics at the universities of Graz, Vienna, Munich and Leipzig. He advanced the kinetic theory of matter, basing his researches upon the kinetics of gases. He attacked problems of light and electricity along the lines of Maxwell's theory and aided in establishing the general acceptance of that theory in scientific circles. His published scientific works include the posthumous collection *Scientific Treatises*, which appeared in 1909. He committed suicide at Duino, Sept. 5, 1906. See also STEFAN'S LAW.

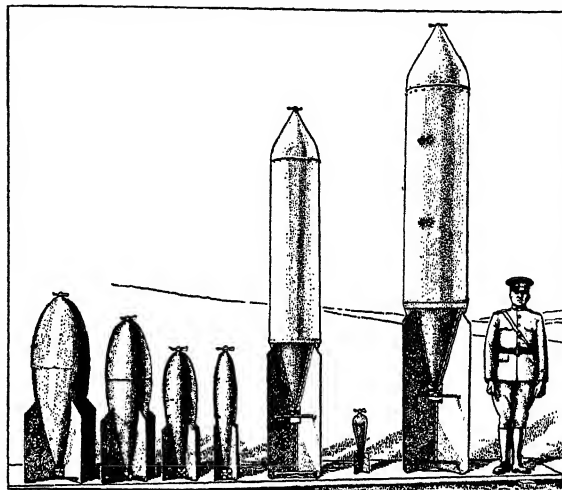
**BOMB**, a steel case loaded with explosive (see EXPLOSIVES) and fused, intended for destructive purposes. A land bomb or mine is used to protect critical areas against the passage of an enemy. Tank mines are small, high explosive bombs that are buried in the earth and set off by the weight of a tank passing over them. They are usually of sufficient strength to turn over a fighting tank on its side or back or to break its tracks.

Depth bombs (see DEPTH CHARGES) are designed to explode at a desired depth from the surface of the sea. They are effective over a wide radius against submerged SUBMARINES. Submarine mines are large, specially constructed bombs, designed to be anchored at a given distance below the surface of the water, for the protection of harbors and channels from hostile ships. They may be exploded from shore or by contact with a ship. Extensive mine fields were used in the North Sea and in many European harbors during the World War.

Aerial bombs are designed to fall in a true trajectory when released from an airplane or airship. The ogival or conical head is provided with a small propeller which rotates when the bomb is released, arming the nose fuse, then falling off after unscrewing its stem. The long steel body is filled with a high explosive such as T.N.T. or amatol. The rear is fused to insure positive action in striking and is equipped with vanes to guide the bomb, the vanes acting in the same manner as the feathers on an arrow. Aerial bombs range in weight from 15 to 4,000 lbs., each size being intended for a definite destructive mission. The heavier bombs are carried by special heavy aircraft equipped with carrying racks and release mechanisms. Attack planes operating against troops in the field or columns on the march use 15 or 30 lb. bombs. Heavier planes attacking ammunition dumps and in-

dustrial facilities use 100 to 300 lb. bombs. The larger bombs are employed against cities and areas to be damaged.

While most bombs are charged with high explosives, gas, incendiary and chemical bombs are readily



COURTESY U.S. DEPT. OF WAR

UNITED STATES AIRCRAFT BOMBS

Reading from left to right: 1,100 lbs., 600 lbs., 300 lbs., 100 lbs., 2,000 lbs., 25 lbs., 4,000 lbs. (demolition bomb)

constructed if either belligerent should begin their use. Also thermit incendiary bombs have been used with considerable effect in tests against ships of war and against ice jams in rivers.

Ballistic bombs are used in explosive laboratories to confine the products of explosion to determine the amount of gas generated by various explosives, the character and rate of generation of such gas and the amount of heat developed by the explosion.

C. G. M.

**BOMBARDIER BEETLE**, any species of ground beetle of the genus *Brachinus*. The wing covers of the adult beetle are dark blue or blackish or greenish blue. When pursued, it explosively discharges an ill-smelling fluid from little sacs at the hind end of the body, which in contact with the air changes to a gas which looks like smoke. Under cover of this "smoke-screen," the beetle escapes. The discharge may be repeated rapidly four or five times.

**BOMBARDMENT**, a continuous firing by guns or howitzers against a definite target for the purpose of destroying it or of driving off its defenders prior to attack. In the bombardment of the fortifications at the Dardanelles, the British battleships used all their large caliber guns. See WORLD WAR; FORTS; SIEGE OPERATIONS.

**BOMBAY**, the second city of India, first if Howrah be excluded from the Calcutta agglomeration; the chief seaport of western India and the seat of the Bombay Presidency. It is built upon the small island of Bombay (in 18° 55' N. lat., 72° 54' E. long.), which is shaped much like Manhattan Island, New York City. During the year 1900 the city lost about

one-tenth of its population through the plague. Pop. 1921, 1,175,914; 1931, 1,157,851.

Bombay owes its eminence to several factors: its excellent harbor; its command of two gates through the Eastern and Western Ghats, two mountain ranges forming the southeastern and southwestern boundaries of India; its position on that side of India which faces Europe, being the first important place reached by vessels from Europe and the Suez Canal; and the richness of its hinterland, including as it does the great cotton lands of the Bombay DECCAN. There are other factors which have proved favorable to its rise: the suitability of the climate for cotton spinning and weaving, and the presence of water-power resources in the Ghats nearby.

The city consists properly of two parts, a native and European quarter, the latter stretching along the shore of the bay where a line of handsome buildings, the cathedral, the university, the secretariat, the new high court, the post and telegraph offices, presents an imposing view when seen from Malabar Hill, at the southwest point of the island. The native city has several long streets, which are the finest in India. Until recently the sanitation of the native area was bad and malaria was especially prevalent. Splendid work, however, was done by the Bombay Improvement Trust, which gradually improved conditions in the slum areas. Few cities in the world have a greater variety of race types. The Mahratta race is the dominant element, but there are Parsees, Afghans and Sikhs from northern India, Arabs, Bengalis, Rajputs, Chinese, Japanese, Malays, Tibetans, Singhalese, Siamese and Negroes. Among religions are the Hindu, Mohammedan, Parsee, Jain and Christian. The Hindus constitute nearly two-thirds of the total, the Mohammedans about one-fifth. Sixty-three different languages or dialects are said to be used within the city limits. English is spoken by many natives, especially in the Parsee merchant community.

There is a large export trade in raw cotton, cotton yarns, oilseeds, wheat, condiments, myrobalans, goat skins and manganese ore. The island was first visited by the Portuguese and acquired by them in 1534. In 1661, through his marriage to the Spanish princess, Catherine, it came into the possession of Charles II. Seven years later the East India Company received the island from Charles. The modern city was founded by Gerald Aungier (1669-77).

**BOMB CALORIMETER**, an instrument for determining heats of combustion (*see* COMBUSTION, HEAT OF). It consists of a strong steel bomb, usually 3 or 4 in. in diameter, either spherical or cylindrical in shape. A suitably prepared sample of the substance under test, as, e.g., powdered coal made into a briquette, is placed into a small platinum dish supported near the center of the bomb. The cover of the bomb is then screwed on and pure oxygen under pressure is admitted through valves in the cover. After the bomb has been connected to an electric circuit for firing the sample, it is immersed in a known amount of water in a CALORIMETER. When fired, the sample

burns completely and the heat thus generated is absorbed by the water. The temperatures of the water before and after ignition are recorded. Assuming that the water equivalent of the bomb and calorimeter is known, the heat produced by the combustion can then be computed as in any calorimetric process (*see* CALORIMETRY). From this, and the mass of the sample, the heat of combustion in CALORIES per gram or in BRITISH THERMAL UNITS per pound can be calculated. The water equivalent of the bomb and calorimeter is usually found by burning a standard sample of some material for which the heat of combustion is known accurately.

The bomb calorimeter is used primarily for solids, although the heats of combustion of liquids can sometimes be determined by it. W. W. S.

**BOMBERS.** *See* AIR FORCE.

**BOMBING AIRCRAFT.** Bombs are carried on the under surfaces of airplanes and are dropped by operating a release mechanism when the bomb sight shows the airplane has reached the proper altitude to insure a hit. In bombing, the flight is usually as nearly horizontal as possible. The bomb sight is fitted with a pendulum or other arrangement to establish the direction of the vertical. By its mechanism it computes automatically the correct aiming allowance ahead of the vertical, provided the sighting telescope is kept pointed at the target and it indicates the proper dropping time. The pilot by automatic instruments (*see* AIRCRAFT INSTRUMENTS) is directed to a course which will give the correct deflection. When a number of planes bomb in formation, it is usual for all to release bombs simultaneously so that the bomb salvo is spread out as much as the bombers are in the formation, and so that the target may escape unhit on fewer occasions. Another form of attack which is particularly suitable for surprise work with lighter planes is dive-bombing in which planes dive towards the target at great speeds from considerable altitudes and release their bombs merely by eye just prior to pulling out of the dive and leveling-off at relatively low altitudes. Frequent bombing practices of all sorts establish percentages of hits to be expected and occasional tests against obsolete ships determine the damage which hits will produce. G. L. S.

**BONA**, Africa, an Algerian seaport on the Mediterranean coast near the mouth of the Seybuse River, defended by Fort Cigogne; Constantine lies 136 mi. to the southwest and Tunis 220 mi. to the east by rail. Walls pierced by four gates enclose the town, which is about 2 mi. in circumference. A French atmosphere has permeated the town and can be witnessed in its fountains, promenades, reading rooms and theaters. It has one of the finest harbors of the African coast, permitting entrance to vessels of 22 ft. draft, has steady marine communication with Marseilles, Tunis, Algiers and Certe, a telegraph connection with Marseilles and a railroad connection with Biskra, Constantine and Algiers. A lively trade in iron ore, tobacco, coral, cattle, hides and corn is carried on. Tapestries, saddles and native garments



are manufactured. The ruins of Hippo Regius are in the vicinity. Pop. 1926, 51,895.

**BONAPARTE, JOSEPH** (1768-1844), the oldest brother of the Emperor Napoleon I, born at Corte (Corsica), Jan. 7, 1768. He was made an imperial prince by Napoleon in 1804, and in 1806, after the deposition of the Bourbons in Naples, became king of the Two Sicilies (Naples). On June 6, 1808, Napoleon placed him on the throne of Spain, but the Spaniards did not want him and aided by the English he was obliged to fight against the Spanish until, following the French defeat at Vitoria, he left Spain June 21, 1813. After the Battle of Waterloo he went to the United States and became an American citizen. He later visited Europe and died at Florence, Italy, July 28, 1844.

**BONAVENTURA, ST.** (1221-74), Italian theologian, Church statesman and religious mystic, was born at Bagnorea near Viterbo, probably in 1221, of humble parentage. At an early age he entered the order of Friars Minor and completed his studies at the University of Paris under Alexander of Hales, founder of the Franciscan School. He lectured at the University of Paris until 1255 and two years later received the degree of doctor with his friend Thomas Aquinas. Elected as Minister General of the Friars Minor, Bonaventura pursued a policy of moderation and in 1273 was created cardinal-bishop of Albano by Gregory X. Meanwhile, in 1263, his biography of St. Francis had been officially approved as the standard biography of the saint. The philosophical and theological works of Bonaventura have exercised considerable influence upon subsequent thought. Two representative works are the *Itinerary of the Mind to God* and the *Reduction of the Arts to Theology*. Bonaventura died during the deliberations of the 14th Ecumenical Council at Lyons, France, on July 15, 1274. He was enrolled among the saints by Sixtus IV in 1482, and his feast day was set on July 14.

**BOND, CARRIE JACOBS** (1862- ), American song writer, was born at Janesville, Wis., Aug. 11, 1862. In 1903 she published *Seven Songs* which received immediate popularity. *A Perfect Day, I Love You Truly* and *Just A-wearyin' for You* are numbered among her 175 songs.

**BONDED WAREHOUSES**, are used chiefly in the administration of CUSTOMS DUTIES to permit the importation of merchandise without immediate payment of the tax. The goods are placed in the warehouse under government supervision to be withdrawn as needed at which time the duties are paid. The system is also used in the case of goods taxable under the INTERNAL REVENUE laws. The warehouse may be operated by the government or by individuals. It is not necessarily a building, but may consist merely of yards or sheds. Various manufacturing processes are sometimes permitted.

The advantage of the warehousing system is that it postpones the payment of the duty until the goods are actually used and thus enables the importer to

avoid tying up his capital. It further renders unnecessary the payment of a DRAWBACK in case the goods are re-exported.

**BIBLIOGRAPHY.**—G. M. Fisk and P. S. Pierce, *International Commercial Policies*, 1925.

**BONDING.** See MORTAR.

**BONDS** are promises to pay certain sums of money on certain fixed dates, acknowledging fixed indebtedness, promising also a fixed rate of interest and usually, but not in all cases, pledging security. Bonds are issued by governments or business corporations in return for loans. They must be signed and sealed. Those bonds which are unsecured are called DEBENTURE BONDS, or INCOME BONDS. A bond is a contract to pay a stipulated amount with maturity of interest and principal set forth and other rights of the holder made clear. While the bondholder is a creditor, the stockholder is an owner, or debtor. As such, the bondholder's claim on ASSETS and earnings comes before that of the stockholder. The stockholder is a speculator in the future success of the enterprise; the bondholder is an investor. A company owes its stockholders nothing, but the bondholders are entitled to collect the nominal value of the bonds, sometimes plus a premium to be paid on retirement, and may take over a business or see that it is reorganized to protect their claims. While ordinarily bonds must pay a fixed rate of interest, this is not always the case. Some bonds have warrants attached known as "share warrants," which give the owner the privilege of purchasing shares of the company under certain stipulations. There are also income bonds, and adjustment bonds the interest on which depends upon the company's current earnings. There is another type which carries conversion privileges and may be exchanged, under certain conditions, for common stock (see STOCK). In general the fixed rate of interest on most bonds and compulsion of payment of both interest and principal makes bonds more stable in price than shares.

Bonds may be retired, in many instances before their maturity date. This may be done by purchasing them in the open market or through a SINKING FUND which retires a certain number of bonds according to a regular schedule. Some government securities have no maturity date and represent a debt in perpetuity; the 3% French rentes and the 2½% British Consolidated Debt are examples. Civil bonds consist of government, state and municipal issues; corporation bonds are issued by public utilities, industrial corporations and railroads. Discussion of the many kinds of bonds is impossible here owing to their great variety. There are equipment, school, terminal, corporate debenture, personal security, first mortgage, consolidated mortgage, collateral trust, chattel mortgage, straight maturity, callable, perpetual, sinking fund, serial, coupon, registered coupon and registered bonds. They may be classified according to tax exemption, conditions of payment of interest, convertibility, eligibility for investment by savings banks, insurance companies and trust funds, eligibility for government

deposit, etc. Gold bonds specifically promise that payment shall be made in GOLD. This would be highly important if the GOLD STANDARD were abandoned and gold should command a premium. Bonds are also sometimes made payable in foreign currency or in several currencies. See BABY BONDS, DEBENTURE BONDS, INCOME BONDS, LIBERTY LOAN, CONVERTIBLE BONDS.

**BOND STREET**, a thoroughfare at the eastern boundary of MAYFAIR, London, England, noted for its fashionable shops and tailoring establishments. Named for Sir John Bond, its builder, it is divided into the more exclusive Old Bond Street, dating from 1686, which extends north from PICCADILLY, and New Bond Street, opened in 1721, extending farther north to OXFORD STREET.

**BOND VALUATION TABLES** are mathematical compilations in table form, which enable investors and bond dealers to ascertain the value, at any date, of BONDS having a fixed maturity. Such tables are necessary because of the immense volume of trading in bonds having varying rates of interest and different maturity dates. With them the bond buyer is able to determine quickly the net return on bonds purchased at a certain price. The tables are arranged to cover semi-annual periods of maturity from six months to 50 years, and yield and values for interest rates of from 3 to 7%. Such tables help materially to speed up the operations of securities dealers, eliminating the need of calculating each individual issue of bonds. The usual valuation table is accurate to within 10 cents on a \$10,000 bond maturing in 20 years. More extended tables give accurate figures to the nearest cent on a \$1,000,000 bond. There are also tables for calculating the value and income of CONVERTIBLE BONDS and serial issues. Municipal bond tables are used in Canada to figure the cost and net income of municipal issues which must be repaid periodically in a manner to retire the issue within a certain time, during which time interest is being paid.

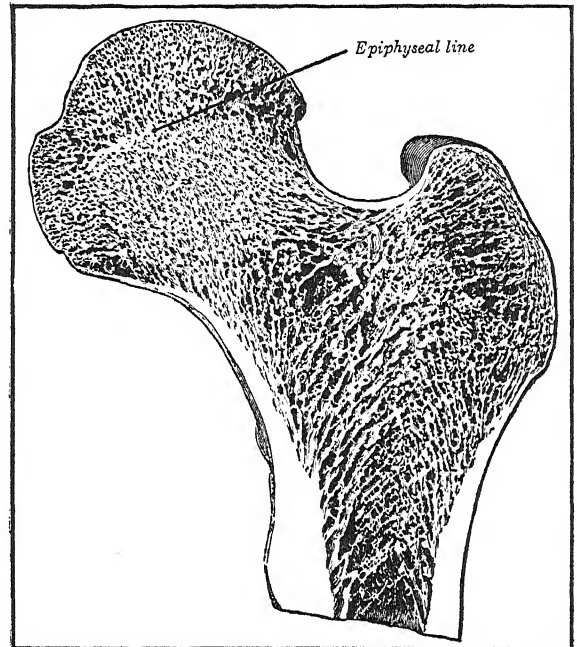
**BONE**, a very hard and rigid form of CONNECTIVE TISSUE found in vertebrate animals, which forms the SKELETON which supports the soft structures of the body, encloses delicate parts to protect them from injury, and furnishes a series of lever bars for the application of muscular energy. Bones contain a type of connective tissue, marrow, which forms the blood cells and introduces them into the circulating blood. Bones also serve as a reservoir of CALCIUM for the body.

Since bones serve as the attachments of the muscles, it is obvious that their shapes and markings will largely be influenced by the muscles arising from or fixed to them. Furthermore, the bones of persons whose muscular systems are well developed will exhibit stronger surface modelling. The bones are classified according to their shape, long bones in the arm and forearm, short bones in the wrist, flat bones in the skull, and irregular bones in the face. Their surfaces show processes, ridges, spines, tubercles, and also pits, grooves, notches, foramina and canals. The furrows and foramina generally conduct blood vessels

and nerves, or are for the attachment of tendons.

The surfaces of bones are everywhere covered with a membranous layer of connective tissue, the periosteum, except where the bones are in contact in the joints. The joint surfaces are covered with CARTILAGE, which furnishes a smooth contact between bones. (See also JOINTS AND LIGAMENTS.) The periosteum carries vessels and nerves to the bone, and serves as a source of new bone formation during growth or following fracture.

If a longitudinal section be made of the upper end of the femur, it becomes apparent that the bone is made of two kinds of bony tissue—compact and spongy (Fig. 1). The enlarged ends are filled up



FROM H. GRAY, ANATOMY OF THE HUMAN BODY. LEA AND FEBIGER

FIG. 1. LONGITUDINAL SECTION OF UPPER FEMUR, SHOWING SPICULES TURNED ALONG LINES OF FORCE

with spongy bone. They are connected by a long tube or shaft, the wall of which is compact bone. The spongy bone is covered on its surface by a thin paper-like layer of compact bone. The tubular structure of the shaft gives it a much greater strength in proportion to its weight than would be possible in a solid structure. The large central cavity is filled with marrow, and is continuous with the irregular marrow spaces in the spongy bone which become steadily smaller towards the ends. Their walls are made of delicate plates and spicules which are not arranged in haphazard fashion, but along definite lines. These are the lines of strain to which the bone is subjected by the activities of the body.

Compact bone will withstand a crushing force of more than two tons per cubic inch, and the shaft of the femur will withstand a twisting or bending force of more than ten times the body weight. It gets these qualities from its structure, which is shown in

Fig. 2. The outer part of the compact tube differs from the inner. It consists of several layers or lamellae,  $1/5000$  inch thick, wrapped all around the shaft. Between them are bone cells, enclosed in

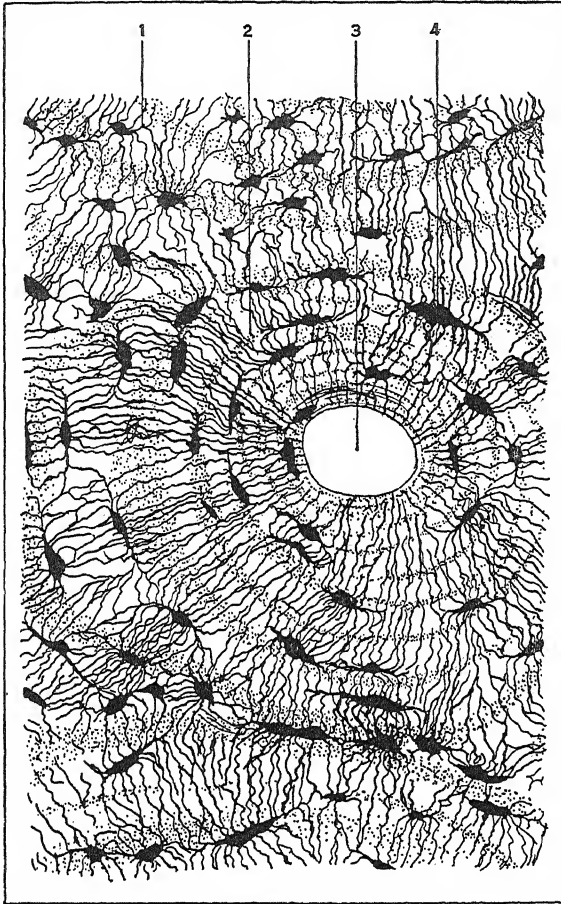


FIG. 2. HAVERSIAN SYSTEM AND PORTIONS OF TWO CONTIGUOUS SYSTEMS IN CROSS SECTION OF LONG BONE

1 Can., canaliculi; 2 Lam., lamella; 3 H.C., Haversian canal; 4 Lac., lacuna, occupied by bone cell

lacunae, each of which gives off many fine hair-like processes, perforating the lamellae through minute canals, the canaliculi, and communicating with processes of other bone cells. Through them nourishment reaches the bone cells and waste products are removed. The lamellae are composed of parallel bundles of white fibers. The interspaces are filled with calcium salts. The fibers give the bone its tensile strength, and the salts its hardness and rigidity.

The inner part of the compact tube is composed of the same elements as the outer part, but the lamellae are tightly wrapped around many tiny cylinders like microscopic paper lead pencils. They are arranged concentrically around small, longitudinally disposed canals. These Haversian canals carry the blood vessels. The canaliculi are arranged radially to permit interchange of substances between the outer lamellae and the blood stream.

Bone is formed by the enlargement of centers of

ossification in membrane or in cartilage. The process can be seen in Fig. 3. Ossification begins in the center and travels towards the ends. Consequently the process may be followed through its stages from the

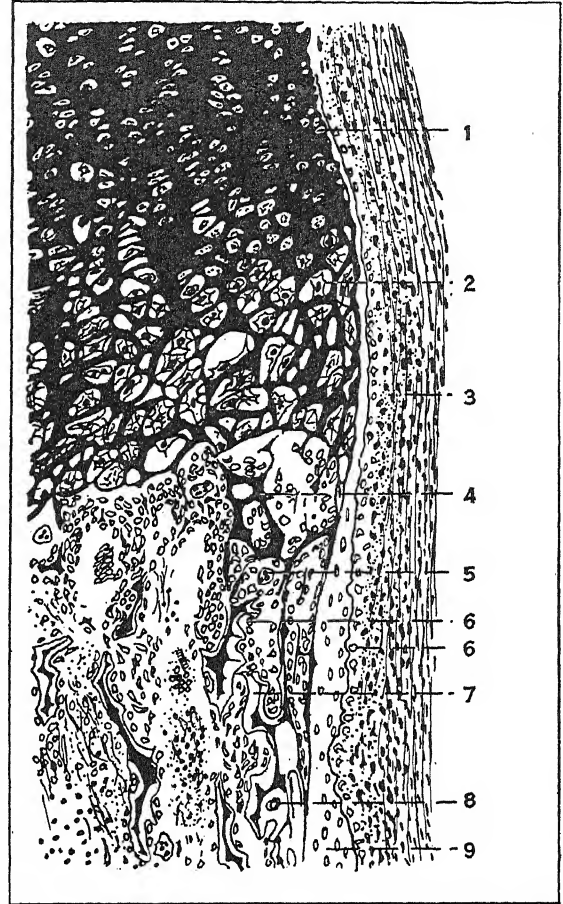


FIG. 3. OSSIFICATION BY REPLACEMENT OF CARTILAGE

1, cartilaginous lacuna; 2, enlarged lacuna; 3, periosteum; 4, cartilaginous spicule; 5, osteoclast; 6, osteoblast; 7, endochondral bone; 8, bone cell; 9, perichondral bone

top of the figure. Unchanged cartilage is indicated by 1. The lacunae of the cartilage cells enlarge (2) and line up in longitudinal rows. The partitions separate the enlarged lacunae of each column, leaving long spicules of cartilage (4), which by this time has taken up lime salts itself. Vessels and accompanying cells invade the shaft of disrupting cartilage. These cells have the power of laying bone down on the spicules, and are called osteoblasts (6). On the outside of the shaft, bone is being added by the periosteum (3) at the same time these changes are occurring, so there results bone of two origins, endochondral (7) and perichondral (9). This embryonic bone is very small; it must grow. This involves rearrangement. The first formed bone is destroyed. Huge cells (osteoclasts, 5) effect its continual resorption: it is as continually rebuilt on larger patterns. This resorption produces the great marrow cavity in the shaft of the adult bone.

Growth in thickness is by periosteal surface addition: growth in length is endochondral and takes place only in the cartilage plates of the epiphyses.

In long bones, a center of ossification appears at the center of the shaft and in most cases a secondary center at either end (epiphysis). A plate of growing cartilage is left between. It becomes ossified between the ages of 16 and 21. Growth in length ceases then. Additional centers may be present, but the number, time of appearance, and time of fusion with the rest of the shaft is very definite in each case.

Mineral material forms 69% of bone, the remainder being organic. The mineral material may be removed by acids, and the organic matrix left has all the structure of bone and may be tied in a knot in the case of long bones.

Exclusive of water, the composition of bone is as follows:

Organic substances .....	31.0	per cent
Calcium phosphate compounds .....	58.2	" "
Calcium carbonate .....	7.0	" "
Calcium fluoride .....	1.5	" "
Magnesium phosphate .....	1.3	" "
Sodium chloride .....	1.0	" "
Total .....	100.0	per cent

For description of the individual bones, see SKELETON. The function of the marrow is described in BLOOD. See also JOINTS AND LIGAMENTS; CONNECTIVE TISSUE; CALCIUM. B. C. H. H.

**BONE, USES OF.** Bone makes a valuable fertilizer and is frequently defatted, ground and used directly. It may be boiled to remove part of the glue yielding substance and then yields steamed bone meal. It is also used in the preparation of stock feeds, and is a source of GLUE, the best grades of which serve as a source of GELATIN, hence the name, calves' foot jelly. The ash of bone may be removed by a suitable acid. The calcium phosphate is recovered and used in phosphate baking powders and in FERTILIZERS. The finer grades of bone are made into handles, buttons and imitation ivory. Certain bone preparations are used for the case-hardening of steel and bone black is used for various refining purposes. Charred bones can also be used for an ink. Shin bones, knuckles and foot bones yield bone oil and neat's-foot oil. C. R. M.

**BONE MARROW: Activity in, Following Hemorrhage.** See HEMORRHAGE.

**BONER, ULRICH** (14th century), Swiss writer, was born at Berne, early in the 14th century. He wrote in German a collection of 100 fables taken from Latin sources. This work, called *Der Edelstein*, was published at Bamberg in 1461, one of the first German books to be printed. The original edition is one of the rarest bibliographical specimens, there being probably two copies extant. The book was republished at Zurich in 1757.

**BONESET** (*Eupatorium perfoliatum*), a perennial herb of the composite family, called also thoroughwort and Indian sage, common in wet places

throughout the eastern half of the United States and Canada. The stout hairy stem grows from 2 to 5 ft. high, bearing wrinkled perfoliate leaves and very numerous heads of small white flowers in terminal clusters. Infusions made from the bitter aromatic foliage have been widely used in household medicine.

**BONGO**, an African antelope, closely related to the bush-buck, which is restricted to the equatorial forests. This large antelope (*Boöercus euryceros*) stands about 3 ft. 7 in. at the shoulder. It is one of the most brilliantly colored of the group. The male has a bright chestnut coat, beautifully marked with narrow vertical stripes of white, and a tufted tail. Both sexes bear horns. The coloration helps to conceal the bongo among the checkered shadow-and-sun of the forest.

**BONHAM**, a city in northeastern Texas, the county seat of Fannin Co. It is situated near the Red River, 62 mi. northeast of Dallas, and is served by two railroads. The city lies in a fertile farming district producing chiefly corn and cotton. The principal local industries are cotton ginning, milling, and manufacturing cottonseed oil and furniture. Bonham was founded in 1836, and was incorporated in 1850. Pop. 1920, 6,008; 1930, 5,655.

**BONHEUR, MARIE ROSALIE (ROSA)** (1822-99), French artist, was born at Bordeaux, Oct. 22, 1822. She studied painting with her father, Raymond Bonheur, and became a noted painter of animals. The well-known canvas, *Tillage in the Nivernais*, finished in 1848, is generally considered Bonheur's finest work and is now in the Luxembourg, Paris. *Horse Fair*, which attracted great attention at the Paris exhibition of 1863, was purchased by Cornelius Vanderbilt and presented to the Metropolitan Museum, New York, which has also her *Deer in the Forest* and *Weaning the Calves*. The noted *Hay-making Season in Auvergne*, was first exhibited in 1865. Rosa Bonheur died near Fontainebleau, May 25, 1899.

**BON HOMME RICHARD and SERAPIS**, war vessels which engaged in a famous naval encounter, Sept. 23, 1779, of the REVOLUTIONARY WAR. JOHN PAUL JONES, commanding the vessel of war *Bon Homme Richard*, with a squadron of five ships met off the Scottish coast a fleet of 41 British merchantmen convoyed by two men-of-war. Engaging the man-of-war *Serapis*, a powerful ship of 40 guns, in a desperate battle which lasted for nearly three hours, the *Bon Homme Richard* was victorious, although both ships were nearly destroyed. Two days later Jones's flagship sank, the crew in the meantime having been transferred to the captive *Serapis*.

**BONIFACE**, name of nine popes. St. Boniface I, 418-422, was installed by Emperor Honorius, who assisted him in extending the jurisdiction of Roman ecclesiastical law over Illyria. Boniface was canonized. Boniface II, of German origin, born in Rome, reigned 530-532. Boniface III, Feb.-Nov. 607, received from the Greek Emperor Phokas the title of "Chief of all the Churches." St. Boniface IV reigned 608-615;

Boniface V, 619-625; Boniface VI for 15 days in 896. Boniface VII was an antipope set up against Benedict VI, in whose murder he was implicated, then fled to Constantinople, whence he returned in 984 to murder his opponent, John XIV; he died in 985. Boniface VIII, previously Benedict Gaetani, learned and able, was pope, 1294-1303. His aim was to make the papacy the greatest spiritual power on earth and he claimed the right to seat and unseat kings. In the famous bull *Unam sanctam*, he proclaimed spiritual power as transcending the temporal. Most of the sovereigns yielded to him, but Philip IV of France accused him of heresy and simony and he was made a prisoner. He escaped to Rome, but died a month later. Boniface IX was pope at Rome, 1389-1401, while Clement VII was pope at Avignon. He assisted young King Ladislaus of Hungary to the crown of Naples.

See H. K. Mann, *Lives of the Popes in the Early Middle Ages*, 1902; H. Grisar, *History of Rome and the Popes of the Middle Ages*, 1911.

**BONIFACE, ST.** (680-755), called the "Apostle of Germany," was born at Crediton in Devonshire about 680. His real name was Winifred. He studied in a Benedictine monastery in Exeter (693), taught theology and philosophy in Hampshire, and became a priest in 710. Pope Gregory II in 718 authorized him to preach the Gospel to the barbarians of Germany and after five years of active work converting the Germans, he was made bishop in 723. He immediately began founding churches and convents, and when in 732 Gregory III named him archbishop of Germany and empowered him to establish bishoprics, a number of famous German bishoprics resulted. In 746 he was appointed archbishop of Mainz and is believed to have consecrated Pepin king of the Franks at Soissons six years later. St. Boniface was killed while converting heathens in West Friesland at Dokkum, June 5, 755. His remains were taken to the Abbey of Fulda, founded by him. His letters and the canons issued by him are important historical documents revealing contemporary conditions. Brewers and tailors have chosen Boniface as their patron saint. On June 11, 1874, Pope Pius IX proclaimed a world-wide celebration of the day of Boniface's martyrdom.

**BONITO**, the name of several fish belonging to the mackerel family. They are found generally in deep waters, swimming in large schools, but come closer to shore for spawning or in pursuit of food during the summer. The most common bonito (*Sarda sarda*) is plentiful along the warmer parts of the Atlantic coast from Cape Cod to Florida, also in the Gulf of Mexico and the Mediterranean. The California bonito (*S. lineolata*) is found in the Pacific, on the California, South American, and Japanese shores. When caught with other fish, the bonito is sometimes salted and dried, though it has little commercial or food value. Their elongate bodies reach a length of 2 or 3 ft. and their weight is from 10 to 12 lbs. In color they are dark blue above, striped

with black, and silvery below. A closely related fish, the albacore, a small tunny, is often called bonito.

**BONIVARD, FRANÇOIS DE** (1496-1570), Swiss statesman, the subject of Byron's *The Prisoner of Chillon*, was born at Seyssel, Switzerland, in 1496. In 1510 he became prior at the Cluniac priory of St. Victor, and defended Geneva against the Duke of Savoy. Accordingly, he was imprisoned at Gex for two years, during which he lost St. Victor's. Having used armed force against Savoy again in 1528, he was held in the prison of Chillon until 1536. After his liberation by the Bernese he was converted to Protestantism, and was granted a pension from the city of Geneva. He wrote *Les Chroniques de Genève* and *De L'Ancienne et Nouvelle Police de Genève*.

**BONN**, seat of the Rhenish Friedrich-Wilhelm-University, on the west bank of the Rhine, about 16 mi. southeast of Cologne. The four towers of the minster, the Protestant churches, the castle church, the country houses on the Rhine, in the background the Kreuzberg with its church and the dignified bridge offer a fine panorama. Though Bonn was one of the first Roman fortresses on the Rhine, it was of no importance in the Middle Ages until the Archbishop-Electors of Cologne transferred their residence there. The minster is one of the finest Romanesque and transition churches. It was built from the 11th to the 13th centuries. Adjacent is a cloister of the 12th century. The south side of the old city is taken up by the university, formerly the archiepiscopal palace with its various collections. Beethoven's house has been restored to its original condition and arranged as a museum. Pop. 1925, 90,249.

**BONNAT, LÉON JOSEPH FLORENTIN** (1833-1922), French portrait painter, was born at Bayonne, June 20, 1833. His first interest was in religious subjects, but through study in Madrid he naturally came under the spell of Velasquez and later devoted himself almost exclusively to portraiture, his talent being further developed under Cogniet in Paris. He won a great reputation, and executed portraits of the leading Frenchmen of his day, among them Victor Hugo, Pasteur, Thiers and Carnot. He was sought out too by prominent Americans. His portrait of John Taylor Johnston is now in the Metropolitan Museum. One of the finest of his portraits is that of his teacher Cogniet, in the Luxembourg. Bonnat died in Paris, Sept. 8, 1922.

**BONNER, EDMUND** (?1500-69), bishop of London, was born of humble parents about 1500. He studied at Oxford and shortly after 1525 became chaplain to Cardinal Wolsey. Later he tried to help Henry VIII obtain an annulment of his marriage, for which service he was promoted and in 1540 became bishop of London. He worked zealously for repudiation of papal supremacy during Henry's life but after the accession of Edward VI cooled toward the cause and lost his bishopric. He regained it in 1553 when Mary came to the throne, restored Catholicism in his see and began the persecutions of heretics. When



Elizabeth became queen in 1558 he refused unqualified allegiance to her and was deposed and imprisoned in the Marshalsea where he died Sept. 5, 1569.

**BONNET, CHARLES** (1720-93), Swiss naturalist. His first profession was law but natural science was his chief interest. His contributions to science include researches on vegetable physiology, parthenogenesis, polypi, the tapeworm, and the respiration of insects. He discussed the theories of generation in his *Considerations sur le corps organises*. Becoming almost blind in middle life, he began to study philosophy and investigated the physiological condition of mental activity. Bonnet was born at Geneva, Switzerland, Mar. 13, 1720 and died at Genthod, May 20, 1793.

**BONNIVARD, FRANÇOIS DE.** See BONIVARD, FRANÇOIS DE.

**BONONIA**, the capital city of Etruria, now BOLOGNA. It dates back to the 8th century B.C. and was first known as Felisina. It was the Romans who gave the town the name of Bononia, probably for the Boii, whom they had conquered in 191 B.C. It was here that the Second Triumvirate, consisting of Octavius, Antony and Lepidus, was formed. In 189 it was made a Roman colony, and a century later the rights of citizenship were conferred upon its inhabitants.

**BONSTETTEN, CHARLES VICTOR DE** (1745-1832), Swiss writer, was born at Berne, Sept. 3, 1745. He studied at Leyden and in 1774 entered political life at Berne; in 1798 he was forced to leave the country because of his political opinions. He spent 3 years in Denmark and then settled permanently in Geneva, where he wrote *L'Homme du midi et l'homme du nord*, a study of climatic influence upon peoples, and *Lettres Pastorales*, containing remarkable descriptions of Switzerland. Bonstetten died at Geneva, Feb. 3, 1832.

**BONUS**, in general, a payment to an employee by an employer in addition to the agreed upon or normal rate of wages or salary. Usually applied to a systematic scheme of payment by results, devised as a refinement upon ordinary piece-rate (see *PIECE WORK*) in order to avoid objections to the latter. A common method of this sort is called the "task and bonus system." A specific rate of output is fixed as the normal task, for which the normal wages are paid. For specific increments to that output, specific bonuses are paid. The fixing of the task and of the increments is sometimes preceded by scientific study with the intent of adjusting the task to average aptitudes and the increments to a graduated scale of additional skill or effort. Sometimes a maximum is fixed to prevent fatigue or to discourage poor quality. Bonuses are occasionally given for quality as well as for quantity of output. Another use of the term is to designate amounts paid to wage-earners above the union scale, when, on account of temporary boom conditions and shortage of labor, it is possible for the workers to demand more than the rate previously fixed by collective agreement for a term of months

or years. This is infrequent, and has occurred chiefly in building construction. In some trades, individuals are habitually paid more than the union scale because of superior skill or experience, but this extra payment is not ordinarily called a bonus; in these trades the scale fixed by agreement is understood to be a minimum, and variations above it according to ability are expected and normal.

G. S.

**BOOBY** (*Sula leucogaster*), a species of GANNET with brown and white plumage, so-called from its stupid habit of alighting on ships and allowing itself to be captured. It is found in tropic and subtropic seas almost throughout the world, except on the Pacific coast of North America. This bird is of easy and powerful flight and feeds chiefly upon squids and fish, diving for its prey. It lays two chalky-white eggs usually upon the bare sand or rock of an islet. Various other gannets are also known as booby, as the blue-faced booby (*S. cyanops*) and the red-footed booby (*S. piscator*), both of the warmer regions of the New World.

**BOOK.** Picture writings and carvings on rock and cave walls may properly be regarded as the earliest ancestors of the book, since they are capable of interpretation on the basis of the record alone. The portable book first appeared in the form of stone and baked clay tablets, followed by the papyrus volume (see *PAPER*) of the Egyptians. The invention of parchment, possessing the quality of folding without breaking, made possible the codex of the Greeks, the immediate ancestor of the modern book. Under medieval copyists the book industry assumed important proportions, and many choice examples of their work are still extant. The invention of printing from movable type by Gutenberg in the 15th century gave the needed impetus to make book manufacture one of the major industries of the present day.

The typical book has three general sections: front or preliminary matter, text, and final matter. Front matter may be quite extensive, consisting of announcements, the half title, frontispiece, title, copyright, acknowledgment, dedication, contents, table of illustrations, introductions and prefaces. Final matter consists of bibliography, appendix, addenda, index, errata and advertising.

E. W. P.

**BOOKBINDING**, the process by which the leaves of a book are fastened together between two flat boards. This technique, invented for the protection and preservation of valuable manuscripts, succeeded the ancient papyrus or parchment scroll, which had rollers at either end. Like the writing and illuminating of the manuscript itself, bookbinding became an art of the medieval monasteries, and as early as the 6th century it had been developed by the monks to the point where the boards were lavishly decorated with metal and jewel work. The early, or Byzantine, bookbinding of the Middle Ages was taken over by the English monks, who from the 10th to the 14th centuries were the leading bookbinders of Europe. Leather, stretched over boards, was by them stamped with small conventional designs.

The invention of the printing press gave a great impetus to bookbinding, which reached its height in Venice at the beginning of the 16th century. Venetian binding, which is characterized by the decoration of morocco leather with gold leaf, acquired at this time a Maecenas in Jean Grolier, Viscount d'Aguisy (1479-1565), a connoisseur of fine bindings, who devoted a large part of his fortune to the collection of a unique library of richly bound books. The French bibliophile's name is commemorated in the Grolier Club, an organization founded in 1884 for the encouragement of the art.

In France, which led the art until the end of the 18th century, the outstanding names are Nicholas and Clovis Eve (16th century), Le Gascon and Du Seuil (17th century) and Padeloup and Derome (18th century). As exponents of the art in England, mention should be made of Thomas Berthelet, binder to Henry VIII, James Gibson, who worked in the reign of James I, and Samuel Mearne, binder to Charles II. In the 18th century Robert Harley, Earl of Oxford, by having his books bound in red morocco with a central panel surrounded by a tooled border, founded the so-called Harleian style. Roger Payne at the end of the century was the first to employ motives in character with the contents of the book.

Bookbinding, which with the other decorative arts suffered an eclipse during the 19th century, has recently been revived. Like the other applied arts it now stresses simplicity, with emphasis on the functional quality expressed by fine combinations of color and the geometric groupings of large forms. Leather is still the material employed, although in Paris there has been some experimenting with metals. The great pioneer of modern bookbinding, Pierre Legrain, not only introduced modernism into the art, but like Roger Payne advocated the adaptation of binding to books. In this way his bindings, like the illustrations, became an interpretation, through skillful use of texture, color and design, of the author's intention. The school of modern binders which sprang up under the inspiration of Legrain, while creating nothing new, continues to work with his ideas.

**Modern Binding.** Rotary presses may deliver sheets folded into book sections, but the binder usually receives his materials flat from the pressroom. Sheets commonly contain two or four sections of 16 or 32 pages each, which the folding machines rapidly convert into book sections. Most common are the double-sixteen or the double-thirty-two sheets, yielding two sections of 16 or 32 pages each, and the quadruples, yielding four sections, usually 16 pages each. Inspected, counted and bundled into convenient units, the folded sheets are moved to the storage room. Illustration inserts and end papers are attached by pasting, some of which is hand work, but a large percentage is done on machines. School book sections frequently are given special strength by means of muslin guards or stitched reinforcements.

With the preparatory work complete, the sections are stacked in order in the boxes of the gathering ma-

chine, which delivers them one by one to a conveyor so timed that the sections fall upon one another in proper sequence. Samples of gathered books are collected to avoid errors. Book sewers are multiple needle machines that pass threads through the back fold of the section, tying the several sheets together and linking the sections together to form the book. The operator places the sections on the arm of the machine which delivers them sewed at the rear.

Compressing drives air from between the leaves, and reduces books to a uniform thickness. Trimming opens the folded bolts, renders other dimensions uniform, and makes the book ready to receive edge treatment, which may be either staining, sprinkling, marbling or gilding. The back of the book then is given several coatings of hot glue, between which it receives the shaping operations of rounding and backing and the back linings of crash and strong paper. The book is then cased by applying adhesive to the outside end leaves, fitting on the cover and placing it in a press. When the paste has set several hours, the books are taken from the press and stocked for market. Popular books receive individual jackets, school books are wrapped in convenient packages, and sets are assembled in wood or paper cartons. The fitting of covers is assured by making up a blank dummy (using the selected paper) which is compressed, trimmed and shaped to the specifications that are to govern the book. The cover boards and the special finished book cloth can then be cut to proper size, and the covers made up on automatic machines. Stamping, printing or embossing of covers with designs in gold, foils, ink or airbrush colors takes place before the covers are attached to the books.

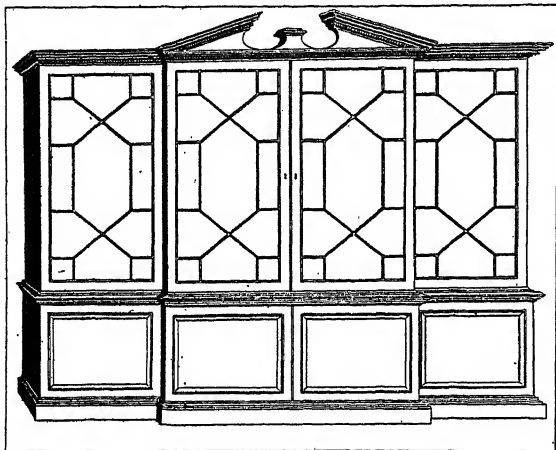
E. W. P.

**BIBLIOGRAPHY.**—J. Zaehnsdorf, *Art of Bookbinding*, 1928; M. Sadleir, *Evolution of Publishers' Binding Styles, 1770-1900*, 1930.

**BOOKCASE**, furniture constituting a receptacle fitted with shelves for the support of books. The evolution of the bookcase begins with the small coffers for hand-written MSS. carried by travelers in the Middle Ages. The modern bookcase is descended from the shelves or cupboard used in the monasteries and palaces where accumulated MSS. were stored. During the evolution doors were discarded in some cases, but are still retained in many pieces to keep out dust. The earliest bookcases were of oak and the earliest extant specimens are in the Bodleian Library at Oxford, England, which date from the late 16th century. From 1720 to about 1800 walnut was extremely popular, but bookcases of this wood are so rare today that it is thought that walnut gave place to mahogany about 1740. Mahogany remained the fashion throughout the 19th century. The great public libraries of the 20th century often have iron shelves. Those in the British Museum, London, are of iron covered with cowhide; those in the Fitzwilliam Library, Cambridge, are of slate. The Library of Congress, Washington, D.C., has steel bookcases.

As row on row of shelves became necessary to ac-

commodate the increasing number of MSS. ornamental designs appeared in the architecture of this once purely utilitarian piece of furniture. Carved cornices, entablature and pilasters relieved the severity and monotony of long rows of books and shelves. THOMAS CHIPPENDALE (d. 1779) excelled in designing



COURTESY METROPOLITAN MUSEUM OF ART

ENGLISH BOOKCASE OF THE 18TH CENTURY

From a drawing in the scrapbook of Thomas Chippendale

bookcases and was especially successful with the massive wing type. Most of the pieces of this period were architectural in inspiration and had highly ornamental glazed doors, with small lozenges encased in fretwork frames. It was only after 1750 that geometric panes of glass came into vogue.

Built-in bookshelves, which have practically replaced the movable type in modern times, are best from an architectural point of view, as they are designed for a particular space. Their popularity also lies in the widespread interest in period decoration, and both the French and English styles which involve the use of pilasters and panelling lend themselves well to the planning of bookshelves. Bookshelves may fill all the spaces which architectural designs make possible, as between columns, below windows and the like. Their height must be governed, however, by the dimensions of the ceiling, the fireplace, the mantel and the wainscoting.

Furniture designers have shown great skill in adapting for use as bookcases many types of cabinets and other wall furniture. The small, hanging shelves so popular for modern bedrooms are outgrowths of the Victorian bric-a-brac cabinet. Bookcases or shelves in a living room give a comfortable, inhabited appearance of intimacy and form a charming background for other furniture.

**BOOKKEEPER**, a person employed to keep accounts, render statements and keep a systematic record of business transactions. Mathematical knowledge, precision and good penmanship are requirements. In a mercantile business a bookkeeper is engaged normally in keeping day-by-day records, as in the journal, cash book and ledger, as contrasted with an

ACCOUNTANT, whose normal duty is to extract periodic records from the bookkeeper's entries. *See also* ACCOUNTANCY.

**BOOKKEEPING.** *See* ACCOUNTING.

**BOOKKEEPING MACHINES**, machines for posting on loose ledger sheets or cards, used particularly when the original entry is a sales slip, invoice copy, voucher or other single item. Each time a posting is made a balance is struck. A special type of bookkeeping machine comprises a combination typewriter and calculating machine which allows statements as well as figures to be entered.

**BOOK LICE**, minute wingless insects of the order *Corrodentia*. They are soft-bodied, grayish or yellowish-white in color, with mouthparts fitted for chewing. They are often found in old books, where they feed upon paste in the bindings. Unless present in large numbers, they do no serious damage.

**BOOK MANUFACTURE** includes a number of specialties that have divided the industry into several recognized groups. Several plants may attempt two or more lines, but few make all kinds. Edition binders stand at the head in importance of product, their plants being equipped, like factories, to turn out vast quantities of books (*see* BOOKBINDING) quickly and economically. Automatic machines and much efficiency characterize these organizations. Their products comprise the millions of popular and fiction works, educational texts and subscription books. Job binders may handle small editions, but their orders are often for single books to be bound, rebound or repaired for owners and private libraries. European publishers furnish many of their books in cheap paper covers, assuming that customers will engage binders to cover their books after their own taste. Hand work, fine materials, including leather, and artistic tooling characterize such work.

Library binding has grown to important proportions with the multiplication of lending libraries. The work of library binders lies in the creation of bindings of special strength and durability, to withstand the wear of frequent and rough handlings. New books are frequently treated thus before being put in circulation. Blank-book houses specialize in bound and loose-leaf forms for commercial and public records. Their special facilities provide for paper ruling and bindings (*see* FORM PRINTING) of maximum durability. Pamphlet binding is the simplest process of all, and is the most engaged in. It includes the production of multiple page circulars, booklets and magazines. The binderies are almost always adjuncts of printing concerns which have added equipment for folding, wire stitching and trimming. The manufacture of books has developed into an industry of great magnitude.

E. W. P.

**BOOK OF THE DEAD**, or "Book of Coming Forth from the Day" (into the night of the tomb), ancient Egyptian compositions dealing with the dead and written for the dead, and attributed to the god Thoth, the scribe of the gods. The texts cover a wide range of time, but all provide the dead man

## BOOKCASE



2. COURTESY METROPOLITAN MUSEUM OF ART

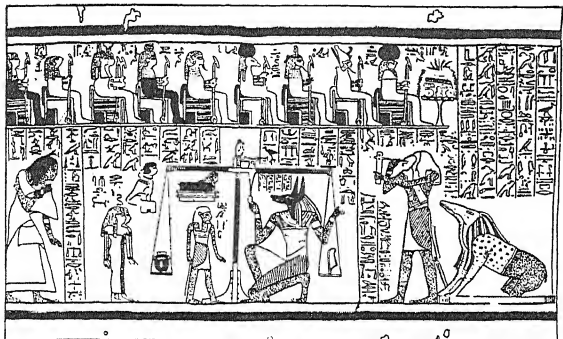
## FAMOUS LIBRARIES

1. Interior of the reading room, Reale Biblioteca Laurenziana, Florence, showing partitioned wood cabinets.
2. Library of the Hotel Gaulin, Dijon, France, designed by Jérôme Marlet in the style of Louis XVI.





with spells, prayers, amulets, etc., to aid him through the difficulties of passage to the Land of Everlasting Life. Many of the prayers contain requests for the things that tend to comfort the dead and minister to



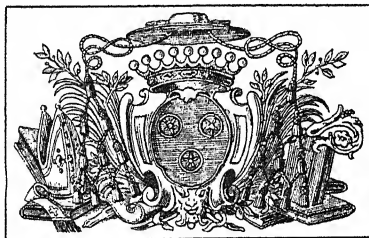
THE WEIGHING OF THE HEART, FROM THE BOOK OF THE DEAD  
From the papyrus of Ani. In the British Museum, London

their welfare. Most of the prayers seek the preservation of the mummy and immortality for the soul. There are hymns, also, in praise of Osiris and other deities. The texts were inscribed upon the inner walls of the pyramids and rock-hewn tombs, and upon coffins and sarcophagi, both inside and outside, and papyri portions were buried with the dead. If strings of petitions for sepulchral offerings were buried with the dead, the theory was that the dead might be nourished by these offerings transmuted into food by the power of the priest.



OLDEST PRINTED BOOKPLATE  
KNOWN, MADE IN 1480

**BOOKPLATE**, a label placed in or upon a book to denote ownership of the volume. In Assyria and Babylonia have been found small clay tablets which are supposed to have served the same purpose as the bookplate of to-day, but bookplates are



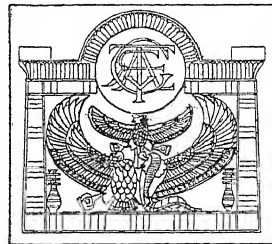
BOOKPLATE OF BISHOP BOSSUET

generally considered to have originated in Germany in the 15th century. The earliest known bookplate is dated 1480, and belonged to a monastery in Swabia. Albrecht Dürer, the German artist, is called the "father of bookplates" because his engraved designs first gave bookplates artistic merit. The earliest book-

plate undoubtedly by Dürer is dated 1516 and was made for Hieronymus Ebner of Nuremberg. Allegorical subjects, quotations from the classics, the owner's name, his coat of arms and favorite pastimes, and the Latin phrase *ex libris* are prominent features of bookplate design. Paul Revere and Nathaniel Hurd of Boston were the first American bookplate engravers.

### BOOK PUBLISHING.

There are more than 200 publishers of books in the United States, more than 10,000 volumes being published in 1930. The largest general publishing houses



BOOKPLATE  
Theophile Gautier's bookplate.  
Designed from an Egyptian  
jewel

issue elementary, high school and college texts, religious books, medical books, juveniles, fiction and non-fiction for the general public, business books, *de luxe* special editions, and reprints at lowered prices, some owning and managing their own presses and bookstores. Of the largest houses, one or two publish only reprints and low-priced editions. Others specialize in sets of books or sell books direct by mail.



COURTESY AMER. ANTIQUARIAN  
SOCIETY, WORCESTER, MASS.

WASHINGTON'S BOOKPLATE

The book publisher, both as Editor and merchant must select books from the hundreds of manuscripts submitted to him and then see them through the long and complicated process of printing, promotion and selling. The great publisher has always possessed this rather unusual combination of qualities. Since he is catering to the changeable taste of the public, his should be the type of mind that reflects the public's wishes and needs and even predicts what those will be months in advance. The wider his literary background and interests are the better.

It is difficult to say what the best preparation for being a book publisher is. The president of one famous concern started as a shipping clerk, another wrote advertising copy for a magazine, another sold books "on the road." Selling experience of any kind is valuable. Newspaper or magazine training, knowledge of a printing plant, of a bookstore and of advertising may prove an asset. Because book publishing deals with a product that is dear to the heart of the public and seemingly often set apart from the marts of trade, it should not be forgotten that its practice is as rigorous, its conventions as stern, and its detail as humdrum and as meticulous as in the manufacture and sale of other products designed for the pleasure and consumption of a large public.

J. FA.

**BOOK SCORPION**, a popular name for members of the pseudoscorpion family *Chernetidae*, also known as false scorpions. They are small arachnids, distantly related to the true scorpions, which they resemble in looks. Only a few of them, *Chelifer cancroides* and *Chiridium museorum* for example, are really found among books. Others live under stones, leaves, bark or in similar dark places, in all parts of the world, where it is not too cold. Book scorpions feed largely on mites. They produce silk, which they use to make little round cocoons, to protect themselves when they moult or hibernate. The eggs, 17 in number, are carried by the female on her abdomen, and the young remain with the mother for some time after being hatched.

**BOOK VALUE**, as used in ACCOUNTING, has reference to the value at which particular items of ASSETS, liabilities, and proprietorship are carried on the books. Thus, a plant site costing \$50,000, 20 years ago and so recorded on the books has a book value of \$50,000 even though its present market value may be many times that sum. There are many different kinds of value which must be considered in business. Thus, taxable value, sales value, insurable value, replacement value or cost, scrap value, forced-sale or liquidation value, sound value, fair value,—all have their places in connoting characteristics of value under certain conditions. There is a well-recognized body of principles in accordance with which the values of the different items of assets, liabilities, and proprietorship should be shown on the books of account of a going concern as distinguished from a liquidating concern or one offered for sale. Such value is termed going-concern value and is analogous with book value as shown by the books of a going concern at the close of a fiscal period when those books have been properly adjusted. In the interim between periodic adjustments some book values may not conform with correct going-concern values. This is so because of the lack of need for such daily conformance and the cost of securing it when correct information periodically secured satisfies all practical requirements. Thus, it is not usually necessary to reflect on the books the daily amount of DEPRECIATION of plant and equipment assets, a monthly or other periodic showing of this satisfying all practical needs.

The principles of going-concern or book valuation may be stated briefly, by asset classes. CURRENT ASSETS are, in the main, to be valued at the estimated amount of CASH which will be realized by them in the normal course of business. Thus, in valuing the receivables an estimate is made of the probable loss from uncollectible items, which loss deducted from the gross receivables outstanding gives their true estimated cash realizable value. This deduction is reflected on the books by a credit entry in an offset or valuation account titled Reserve for Doubtful Accounts. Merchandise is usually conservatively valued at cost or replacement cost whichever is the less. The FIXED ASSETS are valued at cost less accrued depreciation. This is accomplished by means of valuation

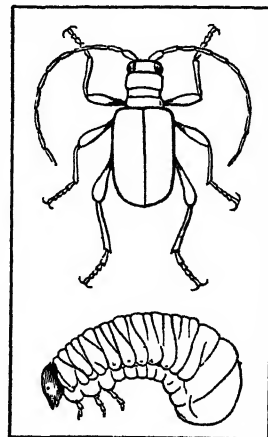
accounts titled Depreciation Reserves. Other assets do not follow general rules but are valued as circumstances indicate. The valuation of liabilities is usually satisfied by ensuring that all such items are fully stated on the books, the amounts at which they are to be valued usually presenting little difficulty. Inasmuch as net worth items are residual values, i.e., those determined by the difference between assets and liabilities, the only problem of value in this group relates to the proper distribution of such residual value as between invested CAPITAL and profits retained in the business as a part of the net proprietary interest at a given time. R. B. K.

**BOOKWORM**, a name given to the larvæ of several beetles which feed on the paste, paper and bindings of books. A familiar species is *Sitodrepa panicea*, of family *Ptinidae* (*Anobiidae*), of which both beetle and larva are destructive to books. The larvae are cinnamon brown in color, with cylindrical, curved bodies, six legs and no eyes. They require a year or more to reach full development as adult beetles.

**BOOMERANG**, a special type of flat and curved throwing club, best known among the aborigines of Australia. Two types of boomerang are recognized. The first, the returning boomerang, is a sharply curved stick, about two feet in length, flat on one side, and slightly convex on the opposite side. The second, the non-returning, or fighting boomerang, is curved in the form of a crescent. When thrown at a mark the returning boomerang circles in the air and returns to the approximate position from which it was thrown. The fighting boomerang can be thrown effectively for a distance of six or seven hundred feet.

A similar throwing club, called a rabbit-stick, is still used in rabbit hunting by some Southwestern Indian groups and has been excavated in several prehistoric sites in southwestern United States. Similar weapons have also been reported from ancient Egypt and India, but these, like the American examples, do not return to the thrower.

**BOONE, DANIEL** (1734-1820), American pioneer, was born near Reading, Pa., Nov. 2, 1734, of Quaker parents. The family moved to the Yadkin Valley of North Carolina in 1750. He became famous for his courage and ability as a woodsman, hunter, rifleman, and Indian fighter in the frontier regions of North Carolina, Virginia and Kentucky. In 1775, he led the first group of settlers to the projected colony of the Transylvania Co. in the region which was afterwards Kentucky. He erected a fort which was later known as Boonesborough. Ejected from



BOOKWORM OR SPIDER BEETLE  
(*Ptinus fur*). Adult bookworm  
and larva enlarged

his Kentucky lands because of improper entry on the land books, he went to western Virginia in 1788, and in 1798 or 1799 moved to Missouri where he died Sept. 22, 1820.

BIBLIOGRAPHY.—R. G. Thwaites, *Daniel Boone*, 1902.

**BOONE**, a city in central Iowa, the county seat of Boone Co., situated 45 mi. northwest of Des Moines,



DANIEL BOONE'S LOG CABIN IN ST.  
CHARLES CO., MISSOURI

on the Des Moines River. Bus and truck lines and two railroads serve the city. There is an airport. The region produces coal, and is fine farming country, growing grain, fruit and vegetables. Live stock is raised on a large scale. The city is a trade market and industrial center, producing principally, hosiery, poultry products and machine and railroad shop products. In 1929 the manufactures reached an approximate total of \$2,000,000; the retail trade amounted to \$6,552,012. Ledges State Park, with caves and interesting rock formations, is in the vicinity. Boone was founded in 1865 and became a city in 1868. It was named for Nathan Boone, son of Daniel Boone. Pop. 1920, 12,451; 1930, 11,886.

**BOONTON**, a town of Morris Co., N.J., situated 30 mi. northwest of Jersey City. It occupies a hilly site overlooking a beautiful lake, part of the Jersey City water system, and a deep gorge of the Rock-away River. Boonton is a popular suburban residence and the trading center for the district which is noted for its mountain lakes. There are a number of local industries the products of which include hosiery, sash weights and rubber. The district was settled about 1700, and Old Boonton, on the outskirts of the present town, was the site of one of the first slitting mills and one of the first iron works established in America. Pop. 1920, 5,372; 1930, 6,866.

**BOONVILLE**, a city in central Missouri, the county seat of Cooper Co., situated on the Missouri River, 104 mi. east of Kansas City. Bus and truck lines, airplanes and two railroads afford transportation. The chief crops of the region are hay and grain. Timber and clay, especially adapted for bricks, are the natural resources. Boonville has a flour mill, shoe factories, marble works and one of the largest corn-cob pipe factories in the world. There are large chicken hatcheries. Boonville was founded about 1817, being named for Daniel Boone. Pop. 1920, 4,665; 1930, 6,435.

**BOONVILLE, BATTLE OF**, June 17, 1861, the first engagement of the CIVIL WAR in Missouri. C. F. Jackson, governor of Missouri, heading the

Secessionist faction, on July 12 demanded the ejection of Unionist volunteers from the state. Gen. Lyons, commanding the Unionists, sailed from St. Louis to Jefferson City, left a small garrison and continued upstream to Boonville, where Gen. Price was attempting to assemble the state militia for Confederate service. Price's army was attacked and dispersed on the 12th. Jackson and Price fled toward the western border, and the movement to push an ordinance of secession through the legislature was thwarted.

**BOOTES** (gen. *Boötis*), the cowherd, one of the oldest of constellations, a feature of our late spring and early summer evenings. The cowherd tends as his flock the seven oxen or Big Dipper. The constellation's brightest star, ARCTURUS, may easily be found by continuing the curve of the handle of the Big Dipper downward. The figure formed by its principal stars has the shape of a huge kite, with Arcturus at the bottom. See STAR: map.

**BOOTH, BALLINGTON** (1859-1929), English religious reformer and philanthropist, was born at London, July 28, 1859, the son of William Booth, who founded the Salvation Army. He worked with his father in England and was sent to Australia as commander of the Salvation Army there in 1885-87. He filled the same office in the United States in 1887-96. When he could no longer agree with his father's ideas of organization, he went to Canada and organized the Volunteers of America in 1896 for the purpose of religious reform and benevolence. He and his wife promoted its growth by writing and public speaking. Booth died in England, June 16, 1929.

**BOOTH, EVANGELINE CORY**, Salvation Army commander, was born in England, the daughter of William Booth, founder of the Salvation Army. For five years she was director of field operations in London, served eight years in Canada as commander and in 1904 became commander for the United States and its possessions. In 1914-18 she was director of Salvation Army war work, and received the D.S.M. She has composed the words and music for many Salvation Army songs.

**BOOTH, WILLIAM** (1829-1912), English evangelist and philanthropist, was born at Nottingham, England, in 1829. He became a minister of the Methodist New Connection Church in 1852 and resigned in 1861 to take up evangelistic work. In the crowded East End of London in 1865 he founded the Christian Mission which in 1878 became the Salvation Army and by his efforts and travels spread throughout the world. He started the *War Cry* and other papers for the Salvation Army, some of which are printed in twenty languages. His son Bramwell succeeded him as general when he died at London, Aug. 20, 1912.

**BOOTH FAMILY**, an Anglo-American group of actors, began its stage history with the work of Junius Brutus Booth (1796-1852), born at London, May 1, 1796. His portrayals of Shakespearean rôles were among the best of his time. In 1821 he appeared in the United States, where he died, near Cincinnati,

Nov. 30, 1852. He was the father of the three Booth brothers, Junius Brutus (1821-83), Edwin Thomas, and John Wilkes, all actors. Edwin Thomas Booth (1833-93), most celebrated of the Booth family, was born near Bel Air, Md., Nov. 13, 1833. A fair comedian, Booth was preeminently a tragedian; his greatest rôles were those of Shakespeare's tragedies. He became manager of the Winter Garden in New York, where he won great success in the rôle of Hamlet. After the assassination of Lincoln in 1865 by Booth's brother, John Wilkes Booth, the actor retired. He returned to the Winter Garden the next year, however, and played there until fire destroyed the building in 1867. Booth then opened his own theater and rapidly rose to the height of his fame. In 1874 he lost his playhouse because of poor financial management, and thenceforth had no established theater in which he regularly appeared. After touring extensively, Booth retired. He died June 7, 1893. His brother, John Wilkes Booth (1838-65), another son of the elder Junius, was born at Bel Air, Md., Apr. 26, 1838. An actor of average ability, his greater interest lay in Confederate politics and the slavery issue. At a performance attended by Lincoln at Ford's Theatre, Washington, on April 14, 1865, Booth entered the President's box and shot him in the head. He escaped, but on the following April 26 his hiding-place was surrounded, and Booth was shot.

**BORACITE**, a natural boron mineral, the chloroborate of magnesium. It is colorless to white, gray, yellowish or greenish and in crystals has a glassy appearance, but when massive resembles white marble or granular limestone. Boracite is found in beds of anhydrite, GYPSUM and SALT, and as part of the famous salt deposits at Stassfurt, Prussia. Boron compounds are valuable as the source of BORAX salts which are used as preservatives, in chemical work, as cleansers, insecticides and in the manufacture of such articles as glass, paints and cosmetics. See DEPOSITS.

**BORAGE** (*Borago officinalis*), a coarse, hairy annual of the borage family, native to Mediterranean countries, and long cultivated in Europe as a garden ornamental and pot-herb. It grows about 2 ft. high, with spreading branches, large, oblong leaves, and handsome brilliant blue or purplish flowers, which bloom all summer. The plant is occasionally used in medicine, also for flavoring.

**BORAH, WILLIAM EDGAR** (1865- ), American lawyer and Senator, born at Fairfield, Ill., on June 29, 1865. He was educated at Southern Illinois Academy at Enfield and at the University of Kansas. He was admitted to the bar in 1889, and began practice at Lyons, Kan. In 1891 he moved to Boise, Idaho, where he resumed his law practice. Although defeated in his first campaign for Senator in 1903 he was elected in 1906, and was four times reelected. He has consistently opposed United States participation in European affairs, leading the Senate "irreconcilables" in their hostility to the League of Nations and blocking favorable action on the proposal that

the United States become a member of the World Court. Since 1924 Borah has headed the committee on foreign affairs as well as other less important committees. Generally classed as an insurgent, Sen. Borah has remained in the ranks of the Republican Party throughout his career. He refused to follow Roosevelt into the Progressive Party in 1912, or to endorse the third party movement led by La Follette in 1924. He has, however, distinguished himself as an eloquent advocate of political reform, tariff revision, anti-imperialism, disarmament and world peace.

**BORÅS**, a city of Sweden, located on the Viskan River, about 50 mi. east of Gothenburg. In 1930 it was the eighth largest city of the country and it is an important manufacturing center, being particularly noted for the large number of cotton and woolen mills. There is a school for weavers. Borås was founded by King Gustavus Adolphus in 1632. Pop. 1931, 38,236.

**BORASSUS PALM.** See PALMYRA PALM.

**BORATES**, salts of BORIC ACID, insoluble in water, with the exception only of those of the alkali metals. The best known borates are those of sodium and calcium, occurring in mineral form under the names BORAX and colemanite, respectively.

**BORAX**, or **SODIUM TETRABORATE** ( $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$ ), a white crystalline salt and one of the chief minerals in which occurs the element BORON. It is found in large quantities in saline lakes and in deposits in Asia and America. Fused borax resembles glass and readily absorbs and dissolves metallic oxides, each with a distinct and characteristic color, upon which property depends its use in inorganic chemical analysis with the BLOWPIPE, as well as in WELDING, since it gives a "clean" surface. Borax is used as a softener for water, to improve the cleansing effect of SOAP by increasing its power to form suds, as an insecticide and mild household antiseptic, as a mordant in printing cotton goods, and for glazing pottery.

Since early times borax has been obtained from the salt lakes of Tibet, where it is called tincal. This was the principal source until displaced by the discovery of the lake deposits of California, Nevada and in Chile. In such arid regions the borates are dissolved from surrounding rocks and carried into shallow basins by occasional rains. When these "playa lakes" evaporate, the borax salts are deposited as a snow-like layer. See also BORACITE; DEPOSITS.

**BORDEAUX**, the commercial and maritime metropolis of southwestern France, capital of the department of Gironde, situated on the Garonne River 15 mi. above its junction with the Dordogne to form the Gironde. The fourth largest city in France, Bordeaux has been important commercially since Roman times, when it was named *Burdigala*. From 1154 to 1453 it belonged to the English, being occupied for a time by Edward the Black Prince. Bordeaux's modern commercial importance dates particularly from the 18th century. The center of the great Bordeaux

wine district, it exports wine chiefly, but also fish, fruit, brandy, turpentine and hides; its principal commerce is with Great Britain, Spain, the United States, South America and French Africa. Industries include shipbuilding, and the manufacture of chemicals, food-stuffs and textiles; the Bordeaux fishing fleets go annually to Newfoundland and Iceland. Among the notable buildings of the handsome city are the Grand Théâtre, of the 18th century, one of the finest theaters in Europe; the 12th century Gothic and Romanesque Cathedral of St. André; the Église St. Michel, with a celebrated tower of the 15th century; the Église Sainte-Croix, of the 12th and 13th centuries, with a superb Romanesque façade; the ruins of a Roman amphitheater, and an imposing modern bridge. The University of Bordeaux, founded in 1441, has faculties of letters, science, law, medicine, pharmacy and theology; in 1929 it enrolled 3,608 students. During the World War Bordeaux was the seat of the French Government for several months in 1914, when the Germans threatened Paris, and was a port of debarkation for the American Expeditionary Force. Pop. 1931, 262,990.

**BORDEN, SIR FREDERICK WILLIAM** (1847-1917), Canadian statesman, was born at Cornwallis, Nova Scotia, May 14, 1847. He studied at King's College, Windsor, and at Harvard Medical School and became a surgeon and honorary colonel in the Canadian army medical service. He sat in the Dominion House of Commons from 1874 to 1882 and from 1887 to 1911. As minister of militia and defence, from 1896 to 1911, he was active in organizing and equipping Canadian forces for South African service during the Boer War, took part in London conferences for the discussion of Canadian cooperation in Imperial defence, and made significant changes in Canadian military affairs. The last British troops were withdrawn from Canada in 1901, during his régime and the practice of appointing a British officer to command the Canadian militia was ended. He died at Canning, N.S., on Jan. 6, 1917.

**BORDEN, GAIL** (1801-1874), American inventor, was born at Norwich, N.Y., Nov. 6, 1801. After spending some years in Mississippi surveying land and teaching school, he went in 1829 to Texas where in addition to conducting a land-office he did surveying and made topographical maps. When Texas became a republic, Borden was appointed collector for the port of Galveston and made the first surveys in connection with laying out the city.

At the time of the California Gold Rush in 1849 he saw the need of concentrated food supplies for emigrants crossing the empty plains and by experimenting produced *pemmican* which proved so practical that it was used by Dr. Kane on his arctic expedition in 1850-53. He next invented the meat biscuit, another highly concentrated food. But his most useful and lucrative invention was a process of condensing milk by evaporation which he patented in 1856. Borden later produced an extract of beef, condensed coffee and tea and extracts of various fruit

juices. From the patents on these several processes he amassed a great fortune. He died at Borden, Texas, Jan. 11, 1874.

**BORDEN, SIR ROBERT (LAIRD)** (1854- ), Canadian Conservative leader, was born at Grand Pré, June 26, 1854. He studied law and was admitted to the bar in 1878. In 1896 he was elected to the Dominion House of Commons from Halifax, and five years later upon the retirement of Charles Tupper, assumed active leadership of the Conservative party. He became known as an able, clean politician, and opponent of reciprocity with the United States. In 1911 his campaigning against the Taft-Fielding Reciprocity Agreement was primarily responsible for the overthrow of Laurier's Liberal ministry; heading a coalition government, Borden succeeded to the premiership. Defeated on his naval program, for Canadian contributions to the British Grand Fleet, he nevertheless retained office.

During the World War, he was prime minister of Canada, and representative at the Imperial War Cabinet of 1917-18. On the conclusion of the War, at the Peace Conference, he insisted that Canada should be represented, due to the part she had taken. In July, 1920, he resigned the premiership, and returned to private life. For his services in the War he was awarded many honors as Grand Cross of the Legion of Honor, Grand Cordon of the Order of Leopold (Belgium); and has held important posts as President of the Canadian Red Cross Society, delegate to the Washington Conference, 1921-22. He is the author of *Rhodes Memorial Lectures*, and *Canadian Constitutional Studies*.

**BORDER RUFFIANS**, name given Missourians who invaded Kansas in an attempt to terrorize the antislavery residents. See KANSAS BORDER WARFARE.

**BORDET, JULES** (1870- ), Belgian bacteriologist, was born at Soignies, June 13, 1870. He received a degree of doctor of medicine at Brussels, and from 1894 to 1901 was a member of the Pasteur Institute of Paris. He returned to Brussels in 1901 to establish and direct the Pasteur Institute there. His many researches and discoveries include the method of diagnosing microbes by sera, the isolation of the WHOOPING COUGH microbe and the method of immunizing patients from that disease. In 1919 he was awarded the Nobel prize for medicine.

**BORE**, the name given to the powerful tidal wave that runs up the estuaries of great rivers or into funnel-shaped bays. It is also known as eagre. The bore occurs especially in large rivers whose mouths gradually widen toward the sea. At high tide a huge amount of water is carried up the river, which, in being driven upstream between continually narrowing banks and into shallower channels, increases greatly in speed as well as in height. It may ultimately advance as a solid wall of water 10 to 20 feet in height, rushing forward at 20 miles an hour or more with destructive violence and roaring noise.

In the Bay of Fundy the greatest difference between high and low tide may be as much as 70 feet, which



produces an enormous bore. In England the phenomenon is well known in the Bristol Channel and the estuary of the Severn, where the tide may rise nearly 20 feet in an hour and a half. The bore of the Amazon River may reach well over 15 feet, and it is known in all three great rivers of India: the Indus, the Ganges and the Brahmaputra. In the Hughli mouth of the Ganges, on which lies Calcutta, the waters penetrate 70 miles inland in four hours. Perhaps the most remarkable example of a bore is that in the Tsientang Kiang, near Hian-Chow, in China, where during the spring tides the wall of water may be 25 feet high and so constitute a menace to navigation.

**BOREAS**, in Greek mythology, the north or north-east wind, son of Astreus and Aurora. (See Eos.) His home was a cave in the Thracian mountains, whence he blew over Greece. A temple was erected to him at Athens for destroying the fleet of XERXES. He is pictured with a long beard and flowing hair.

**BORER MOTH**. Any moth whose larvæ are borers may be called a borer moth and no single species of moth can be thus designated. To the family *Aegeriidae* belong the grapevine root-borer, the currant borer, the peach-tree borers, the pear borer, the raspberry root-borer and the squash-vine borer. Other well-known borers of the family *Gelechiidae* are the pink bollworm and the peach twig-borer. The carpenter moths, family *Cossidae*, are borers. The three commonest corn stalk borers are members of the family *Pyralidae*.

**BORGER**, a city in Hutchinson Co., northwestern Texas; situated 55 mi. northeast of Amarillo and served by the Santa Fé Railroad. Much of this district is devoted to stock-raising and farming, but the chief interests are gas and petroleum industries. The city has oil refineries and ten carbon black factories are found in the vicinity. Borger was founded in 1926. Pop. 1930, 6,532.

**BORGIA, CESARE** (1476-1507). The powerful Roman house of Borgia is known to history chiefly by the acts of Cesare, of his sister Lucrezia and of their father, Pope ALEXANDER VI. Cesare, soldier and ecclesiastic, was born at Rome in 1476. When his father became Pope in 1492, Cesare was made cardinal, an office he shortly resigned. When his brother Giovanni died in 1497, Cesare was believed to have murdered him because of jealousy over the Pope's land gifts to the former. In 1498, Cesare went to France as papal legate and the next year married Charlotte d'Albret, sister of the king of Navarre. In two campaigns with the aid of Louis XII, he conquered Romagna, Perugia, Piombino, and Urbino, and in 1501 he visioned for himself a new kingdom in central Italy. But Alexander's death in 1503 and the election of a Pope hostile to Cesare ruined his plans. He was arrested, but escaped to join his French brother-in-law, in one of whose campaigns against Castile Cesare was killed, March 12, 1507.

**BORGIA, LUCREZIA** (1480-1519), was born at Rome in 1480, and when still a girl was twice given in

marriage by her father Pope ALEXANDER VI. Her third husband, Alphonso, duke of Bisceglie, was murdered in a quarrel with her brother Cesare. In 1501 Lucrezia married Alfonso d'Este, and thereafter devoted her life to literature and art. She died June 24, 1519. In popular fiction and biography, the Borgias have been portrayed as the embodiment of Renaissance treachery; more modern research, however, gives due acknowledgment to Cesare's justice as a legislator, and to Lucrezia's sponsorship of the arts.

**BORGLUM, GUTZON** (1867- ), American sculptor, painter and author, was born in Idaho, Mar. 25, 1867. In 1902 he opened a studio in New York, where his animal sculptures, portraits and murals quickly brought him renown. Among his colossal works are the Twelves Apostles for the Cathedral of St. John the Divine, New York City, a Lincoln head in the Capitol, and the Sheridan Monument, both at Washington. In 1926 he undertook an immense Confederate memorial, cut in bas-relief on the face of Stone Mountain, Ga., depicting Davis, Stonewall Jackson and other Southern leaders among their troops. The next year he began a similarly bold work on the stone of Mount Rushmore, South Dakota, where he proposed to carve memorials to Washington, Jefferson, Lincoln and Roosevelt. The site was dedicated by President Coolidge in 1927.

**BORGLUM, SOLON HANNIBAL** (1868-1922), American sculptor, was born at Ogden, Utah, Dec. 22, 1868, and spent his boyhood on a cattle ranch. With his brother, GUTZON BORGLUM, he studied art at Cincinnati and at Paris under EMMANUEL FREMIET and Rebisso. He then made a special study of the Indians, cowboys and life of the West which he perpetuated in his works including *Stampede of Wild Horses*, *The Last Roundup*, *The Bucking Broncho* and *Just Born*. His *Lame Horse* received honorable mention in 1899 at the Paris salon. He was a Y.M.C.A. secretary with the French army in 1918 and was awarded the Croix de Guerre. Borglum died Jan. 31, 1922.

**BORIC ACID**, or **BORACIC ACID**, a very weak mineral acid ( $H_3BO_3$ ) occurring in nature in the volcanic fumes of Tuscany, otherwise largely in the form of its sodium salt, BORAX. It is a white crystalline powder, sparingly soluble in cold water. In very weak solutions it is used as a preservative for foods.

Boric acid is a mild antiseptic and astringent, which may be used as a dusting powder for wounds or as a wash or lotion, particularly for the inflammation of mucous membranes. Taken internally in anything but minute quantities it may be poisonous.

**BORIS GODOUNOV**, an opera in four acts by MODESTE MOUSSORGSKY, libretto based on Alexander Pushkin's historical drama of the same name; première, St. Petersburg, 1874, New York, 1913. Although uneven in merit, musically and dramatically, the work occupies a unique place in the operatic repertory of all countries, being the foremost of all Russian operas by reason of its incomparable vigor.

While serving as privy councilor to the Czar Feodor,

the feeble-minded son of Ivan the Terrible, Boris Godounov, plots the assassination of Feodor's half-brother, Dmitri. With Dmitri out of the way, and with Feodor suffering from senility, the path to the Russian throne should not prove difficult. Acting on this scheme Boris has the youthful Dmitri killed. As soon as Feodor dies of natural causes, Boris finds himself in a position to proclaim himself master of all Russia. Unfortunately for the prolonged success of his plan, a young monk named Grischka presently escapes to Poland where he identifies himself successfully as the murdered Dmitri. Marrying into a powerful Polish family, Grischka places himself at the head of an army which marches against Boris. To Boris's already haunted imagination, this threat appears as an intolerable new specter, and the murderer of Dmitri dies in horror.

**BORNEO**, a large island of the MALAY ARCHIPELAGO, extending from 7° 3' N. to 4° 10' S. lat.; it has an area of about 285,000 sq. mi. About a quarter of the whole island is known as British Borneo, and the remainder, by far the most valuable section, as Dutch Borneo.

The coast of the island is but slightly indented with bays, and deep inlets are not to be found. As a rule Borneo is bordered throughout by a considerable width of swamp and lowland, except at a few points where there are high promontories. Various ranges of mountains divide the island into sections, the intervening land being low, flat and marshy. Borneo is plentifully furnished with rivers, and although in most cases bars prevent the entrance of large vessels, small craft can navigate for a very large portion of the course. There are no permanent lakes of any great size.

Bisected by the Equator, the island is exposed to the action of the four monsoons. The southeast monsoon is prevalent from April to October and brings the greatest amount of rain. Strictly speaking, there is no dry season, although droughts sometimes occur. The maximum temperature on the coast varies from 81° F. in February to 93° in April. On the whole the climate is hot, damp, and enervating.

Extremely luxuriant, almost the whole island is one vast forest. The vegetation is thoroughly Malayan and is especially rich in palms and forest trees. But the lofty mountain of Kinabalu contains a mixture of Indian, Malayan and Australian plants. Here are numerous rhododendrons 20 ft. high. In the lowlands ferns and orchids are present in endless variety, and ironwood grows abundantly.

Among the animals of Borneo are the elephant, rhinoceros, wild cattle (*Bos banteng*) and monkeys. The most remarkable species of these last are the Proboscis monkey (*Presbytes nasutus*), whose long and fleshy nose gives it a very human aspect, and the orang-utan, of which there are two species, the largest being superior in size to all the anthropoid apes except the gorilla. Reptiles and crocodiles abound. The birds include eagles, pheasants and owls.

It was not until the 16th century that Borneo had

any dealings with the white man, and a certain doubt exists as to what European nation or to what individual can claim the honor of having discovered the island. So far as is known, the Italian traveller, Varthema, was the first European to visit Borneo, probably in 1506, but he seems not to have stayed there. After the death of Magellan in the Philippines, the two remaining ships of his squadron visited Brunei, a portion of the northwest coast, in 1521. The Dutch followed in 1598, and commerce was soon initiated by them. They in turn were followed by the English, who disputed their foothold with the Dutch East Indies Company. The conflict endured throughout the 17th and 18th centuries without any notable profit to either side. But the white man's factories were rendered unprofitable by the stubborn savagery of the uncivilized inhabitants, the treacherous hypocrisy of their innumerable princes and the suspicious hostility of the Chinese. In 1892 British and Dutch agreed to terms which definitely limit the province of either.

**British Borneo.** The northern and northwestern parts of Borneo, roughly a quarter of the whole island, form part of the British Empire. The territory under English influence is organized in three political units: British North Borneo, Brunei and Sarawak.

British North Borneo occupies the northern part of the island and has an area of about 31,106 sq. mi. The territory is under the jurisdiction of the British North Borneo Chartered Company and is administered by a governor resident in the country and by a court of directors in London.

The population of British North Borneo was 257,804 in 1921, and consisted mainly of Chinese and Mahomedan settlers on the coast and aboriginal tribes inland. The Europeans numbered 533; Eurasians, 213; Chinese, 37,856; Malays, 20,263. The number of natives was 197,058, the most numerous being the Dusuns, Muruts and Bajaus. The chief towns are Sandakan (11,963) on the east coast and Jesselton on the west coast.

The chief products are timber, sago, rice, coconuts, gums, coffee, fruits, spices, rubber, tobacco and tapioca. In recent years there has been a rapid rise in the production and export of plantation rubber and tobacco. Mineral oil, coal, iron and gold are obtained, and timber is exported in considerable quantity. The British North Borneo Company holds the land under grants from the sultans of Brunei and Salu. North Borneo was declared a British protectorate in 1888, and ten years later certain border lands were acquired from the sultan of Brunei.

Brunei lies in the center of the northwest coast, between the state of North Borneo and Sarawak. This little state of 2,500 sq. mi. is a British protectorate under the rule of a native sultan with a British resident as adviser. The population (1921) numbered 25,444, including 1434 Chinese, 37 Indians and 35 Europeans. The remainder are Malays and native races. The chief town is Brunei, on the river of the

same name. The old town was actually built over the water of the river, but modern Brunei is now on the mainland.

The greater part of the state is heavily forested and there are many kinds of valuable timber. Agricultural products include sago and plantation rubber which is increasing in importance. Petroleum is known to occur. The exports are rubber, jelutong and cutch, the name given to an extract of mangrove bark. The trade is chiefly via Singapore, and there is a regular steam launch service between Brunei and Labuan. The native industries include boat building, cloth weaving, and silver and brass working.

Sarawak has an area of 50,000 sq. mi., and lies along the northwest coast, north of Dutch Borneo. It is a state ruled by an English rajah. In 1842 the Sultan of Brunei granted control of part of the present area of Sarawak to the Englishman, Sir James Brooke, who thus became the first rajah. The young state was nearly overthrown by a Chinese mutiny in 1857. Additions of territory were made in 1861 and 1905, and in 1888 Sarawak was occupied as an independent state under the protection of Britain. The present rajah, Charles Vyner Brooke, is the third, and succeeded to the title in 1917.

The population comprises mainly Malays and such native peoples as Dyaks, Kenyahs and Muruts, but there are also large numbers of Chinese settlers. The chief towns are the capital, Kuching, about 23 mi. from the mouth of the Sarawak River; Sibuan, about 60 mi. from the mouth of the Rejang River, and Miri, the headquarters of a prominent oil company.

The agricultural products include sago and pepper; plantation rubber is increasing in importance. In recent years very important oilfields have been developed at Miri and Bakong in the Baram district, and the production of oil in 1926 amounted to 633,000 metric tons. The foreign trade has shown a marked increase in recent years; rubber and mineral oil products represent three-quarters of the total value of the exports which also include sago, flour, pepper and fish. Trade is carried on mainly through Singapore.

**Dutch Borneo**, a total area of 206,810 sq. mi., is divided for political purposes into three divisions: the west, south and east. The Malay and Bugis settlers are well-to-do people, renowned for their skill in copper work, brassware, pottery and other handicrafts. Inland, the kind but savage Dyaks are still living their rarely disturbed animistic life, regulated by their environment, and ruled by such superstitious beliefs as good and bad omens, and lucky and unlucky days. The Dyaks are accustomed to long travels for hunting purposes, man-hunting included, and for the cultivation of the soil. The best situated spots are sought even at great distances from villages. The fields are left again after the crop of rice or maize has been harvested. The Arabs, Chinese and Malays are engaged in trading, rubber-planting, agriculture, fishing and mining. Almost all the Europeans are officials.

Yellow diamonds, gold, copper, iron, mineral oils, marble, salt and some coal are mined; but difficulties

of transport and high duties paid to native princes discourage great exploitation. But in recent years the annual output of petroleum rose from 100,000 to 675,000 tons. The most important towns in Dutch Borneo are Banjarmasin, Pontianak and Balikpapan. There are 17 governmental stations. Pop., British Borneo, 1921, 257,804; Dutch Borneo, 1927, 1,822,426.

**BORNEO, BRITISH NORTH.** See BORNEO.

**BORNITE**, an ORE of copper of bronze-like, metallic appearance and of dark, reddish brown complexion on fresh fractures. This color explains the name "horse-flesh ore," while the blue, purple and iridescent tarnishes which quickly develop gave rise to the names "peacock ore" and "purple" or "variegated ore." It is a copper-iron sulphide, particularly rich in copper, which occurs in compact, granular or solid masses and rarely in small, isometric crystals. It is usually associated with the important copper ores CHALCOCITE and CHALCOPYRITE. Bornite is found in ore deposits of igneous metamorphic origin, such as those of Bisbee, Ariz. It is named for Ignatius von Born, an 18th century mineralogist. See also ORE DEPOSITS; METAMORPHISM; ISOMETRIC SYSTEM.

**BORODIN, ALEXANDER PORPHYRIE-VICH** (1834-87), Russian composer, was born at St. Petersburg, Oct. 31, 1834. By profession a surgeon, obtaining his medical degree in 1858, he retained an active interest in medicine and chemistry throughout his life, but a meeting with Moussorgsky directed his attention to music, and he placed himself under the tutelage of BALAKIREV. By dint of hard study he quickly assimilated the principles of composition, and presently began to compose some of the most individual Russian music of the 19th century. Two symphonies, a symphonic poem, *On the Steppes of Central Asia*, several exquisite songs, and the opera *Prince Igor* are among his noteworthy creations. He died at St. Petersburg, Feb. 15, 1887.

**BORODINO, BATTLE OF**, Sept. 7, 1812, the last encounter between Napoleon's army and the Russians at the village of Borodino on the Moscow before the evacuation of Moscow by the Russians and its occupation by the French. With an army of 130,000 men, Napoleon made an attack on the Russians whose forces numbered about 120,000. The Russian army was forced to give way under heavy artillery bombardment and cavalry charges. Russian losses are estimated at 47,000, and those of the French at 32,000.

**BORON**, a light, non-metallic element not found free in nature, but occurring chiefly in the form of BORAX and BORIC ACID. Its chemical symbol is B, and atomic weight 10.82; the element is trivalent and forms combinations with many other elements, among them the oxide, B<sub>2</sub>O<sub>3</sub>, a nitride, BN, and a number of hydroboron, chain-compounds, analogous to the hydrocarbons and hydrosilicons.

**BOROUGH**, originally a town or fortified place; in England an incorporated town having special privileges under royal charter (municipal borough) or a town with the right to send one or more members to Parliament (parliamentary borough). In several of

the American states a borough is an incorporated place of small population, elsewhere called a village. It is also one of the five administrative divisions of New York City.

**BORROMEIO, CARLO, ST.** (1538-84), cardinal and religious reformer, was born of noble parentage at Arona on Lago Maggiore, Italy, Oct. 2, 1538. He received his doctor's degree in law at Pavia in 1599. In the following year his uncle became Pope Pius IV and Borromeo was appointed cardinal of Romagna and later archbishop of Milan. He took an active part in the proceedings of the Council of Trent, and after the death of Pius IV turned his reforming zeal in the direction of correcting the abuses in his own archbishopric. He founded in 1578 the Oblates of St. Ambrose, whose members were to act as assistants and be available to him at any time. The great plague at Milan in 1576 called forth his unusual administrative ability in the organization of relief work. Borromeo died on Nov. 4, 1584. Two years after he died the Borromean League was formed in the Catholic cantons of Switzerland for the forceful expulsion of heretics. Borromeo was canonized in 1610, and his feast is kept on Nov. 4.

**BORROW, GEORGE HENRY** (1803-81), English traveler and writer, was born in Norfolk, July 5, 1803. He was educated at the Norwich Grammar School, in 1820 was apprenticed to a lawyer, but was more interested in the study of languages than of law. He tramped through the British Isles, became a freelance writer in London, and later traveled over Europe as the agent for a Bible Society and, on his own account, as a student of gypsy life, spending most of his time in Spain and Portugal. In 1840 he married and settled on an estate in northeastern Suffolk. In 1843 he published his famous *Bible in Spain*. Among his other works are the partially autobiographical *Lavengro*, 1851, *The Romany Rye*, 1857, *Wild Wales*, 1862, and *Romano Lavo-Lil*, a dictionary of the Gypsy language published 1874. Borrow died at Oulton, July 26, 1881.

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**BORTZ**, poorly crystallized DIAMONDS of dark color, often showing a radial, fibrous structure. They are translucent to opaque, and when powdered are used in polishing diamonds. They are also used in dies for drawing fine wire, and for glass cutting. Diamond fragments of a quality unsuited for gems are also called bortz.

**BOSANQUET, BERNARD** (1848-1923), English philosopher, was born at Alnwick, June 14, 1848. For ten years he lectured at University College, Oxford, going to London in 1881 to lecture and engage in social work. In 1903 he was appointed professor of moral philosophy at St. Andrews University. He was a disciple of his contemporary, Thomas Hill Green, and was also influenced by G. W. HEGEL. His philosophical writings include *Knowledge and Reality*, *Education of the Young in Plato's Republic*, *Social and Internal Ideals* and *The Meeting of Extremes in*

*Comparative Philosophy*. He died at London, Feb. 11, 1923.

**BOSANQUET'S LAW.** See MAGNETIC UNITS.

**BOSCAN ALMOGAVAR, JUAN** (c. 1490-1542), Spanish poet and educator, was born at Barcelona, about 1490. Of noble birth, he attended the court of Charles V, and was entrusted with the education of the Duke of Alva. He wrote his verses in Castilian meter until 1526, when he adopted the Italian *sonnetto*. Thus he introduced the sonnet form into Spain. His works include *Leandro y Hero* and *La Allegoria*. Boscan died near Perpignan, in Apr. 1542.

**BOSNA**, a river of Yugoslavia, tributary of the Save. Its sources are in central Bosnia in the environs of Sarajevo, the capital of the former province. It follows a tortuous northern course and reaches the Save 24 mi. east of Brod. The total length of the Bosna is about 200 mi., but it is an important Bosnian stream, since it flows amidst very picturesque mountain scenery and its restless, foamy current cuts deep gorges through the terrain. An affluent of the Bosna is the Miliatchka which flows through Sarajevo and upon whose bank on June 28, 1914 was assassinated the Archduke of Austria, Francis Ferdinand, a circumstance which became the immediate cause of the World War.

**BOSNIA**, a province of the modern kingdom of YUGOSLAVIA. It is bounded on the west and south by Dalmatia and the Adriatic Sea, on the north by Croatia, and on the east and southeast by Serbia and Montenegro. The capital of Bosnia is SERAJEVO, on the banks of the Miliatchka River.

**History.** The earliest people in Bosnia were the Illyrians, who were divided into pastoral tribes but were governed with Latin institutions. These tribes conceded their control to the Romans in 6 B.C.-9 A.D., the Romans incorporating Bosnia in the province of Illyrium. In the 6th century the Ostrogoths under THEODORIC took possession of the two Roman provinces Dalmatia and Pannonia in which Bosnia was included. At the end of the century the Croats from Eastern Galicia invaded the country, subjugated the Avars, who invaded in the early seventh century, and wrested it from the Romans by the middle of the seventh century. By 900 the Croats had accepted Latin Christianity.

The country was divided into Banats, each ruled by a ban, who was the viceroy of the Croatian king, and Bosnia continued to be a part of the kingdom of Croatia under the name *Rama* until 1376, when Stephen Tvrtko took the title of king of Bosnia, threw off the yoke of Serbia, and extended his territories along the Adriatic. In the next century began the period of the Turkish wars, and ten years after the fall of Constantinople, in 1463, Bosnia became a Turkish pashalic. The oppression of the Turks was frightful, except for religious matters, in which the Moslems were somewhat tolerant. The Turks, however, did leave the Croatian language and customs to the people. Many revolts broke out during Turkish occupation, the most famous under Hussein Beg,

but were invariably suppressed. At the end of the Russo-Turkish War, which broke out in 1877, Austria annexed Bosnia and Herzegovina by the *Treaty of Berlin* in 1878. In 1908 Austria-Hungary assumed complete sovereignty over the two provinces. This act enraged Serbia, who had claimed Bosnia for some time, and nearly caused a war between Serbia and the Dual Monarchy. Six years later in the capital city, Serajevo, a Serbian student assassinated the Archduke FRANCIS FERDINAND of Austria, which led immediately to the outbreak of the World War. By the terms of the Paris Peace Conference in 1919-20 Bosnia was made a part of Yugoslavia.

**BOSPORUS**, also **BOSPHORUS**, a narrow channel running between Europe and Asia and connecting the BLACK SEA with the SEA OF MARMORA. The passage is 18 mi. long and varies in width from 800 yds. to 3 mi. Its maximum depth is about 390 yds. A central current flows from the Black Sea into the Marmora, with counter-currents along the shores and under the surface. The shores are dotted with beautiful villas and palaces.

**BOSS**, or stock, a mass of IGNEOUS ROCK of considerable horizontal extent and indefinite downward extension. It penetrated in a liquid condition into the overlying rocks from a lower reservoir of molten material, and solidified at a great depth beneath the surface. Cooling was slow, so the rock is coarsely crystalline. It is smaller than a BATHOLITH, otherwise the two are similar. In outline it may be dome-like or irregular. *See also* PETROLOGY.

**BOSSUET, JACQUES BÉNIGNE** (1627-1704), French prelate, was born at Dijon, France, Sept. 27, 1627. He was educated at a Jesuit College in his native city and later studied at the College of Navarre, Paris. After filling lesser church offices he became a bishop and soon afterwards tutor to the Dauphin, son of Louis XIV. He was famous for his *Sermons*, later collected and published, which expressed his uncompromising moral and religious discipline, and for his remarkable power as an ecclesiastical orator. His best known works are *Discours sur l'Histoire Universelle*, written for the education of the young Dauphin, and "History of the Variations of the Protestant Churches." He died at Paris, Apr. 12, 1704.

**BOSTON**, a municipal borough and seaport of Lincolnshire, England, lying on the Witham 4 mi. from its mouth in the Wash, 107 mi. north of London. The place name derives from St. Botolph who, in 654, founded a monastery on the site. Boston prospered until the 18th century when the silting up of the Witham ruined it. In 1882 seven acres of docks somewhat remedied the condition. Boston, Mass., is named for the town, and the court, greatly altered, where the Pilgrim Fathers were tried, is in the 15th century guild hall. John Cotton was vicar of the splendid, decorated parish Church of St. Botolph to which belongs the famed Boston Stump, a graceful 190 ft. Perpendicular spire and a landmark for the surrounding 40 mi. A chapel of the church was restored by citizens of the American Boston in 1857.

There are other ancient buildings, including a Shod-friars Hall and the 15th century brick Hussey Tower. Modern Boston traffics in coal, machinery and manufactured goods; has coastal and sea fisheries; and sells agricultural produce, tobacco and oilcake. Pop. 1921, 16,102; 1931, 16,597.

**BOSTON**, capital and chief port of entry of Massachusetts, at the head of Massachusetts Bay and the mouth of the Charles and Mystic rivers, in 42° 21' 30" N. lat. and 71° 3' 51" W. long. The city, 9th largest in the United States and the commercial metropolis of New England, has an area of 47.81 sq. mi. and in 1920 had a population of 748,060; in 1930 of 781,188. Boston is nearly coextensive with Suffolk Co., of which it is the seat. It is 232 mi. by rail northeast of New York City. The city records an average temperature of 28° F. in January, of 72° in July. The average annual precipitation is 40.1 in.

**Geographic Setting.** Boston clusters around an indentation of Massachusetts Bay. The practically landlocked harbor is circumscribed by the water fronts of South Boston, a peninsula dividing Boston Harbor and Old Harbor to the south, Boston proper, and East Boston. Possession of a protected harbor in early days had much to do with the growth of Boston as a seaport. Northeast of Boston proper is a wide passage which connects the Charles and Mystic rivers and is flanked on the west by Charlestown and on the east by East Boston, which is virtually an island. The city proper occupies the site of the original settlement on the southern bank of the Charles River, near its mouth, a peninsula dominated by Beacon Hill. To the south and west of this older section are South Boston and the Roxbury and Dorchester districts. West and on the southern side of the Charles are Brookline and Brighton. The altitude ranges from 15 to 320 ft. above sea level. Directly across the Charles, and between that stream and the Mystic River, are the cities of Cambridge and Somerville, which with 41 other surrounding cities and smaller communities are considered part of metropolitan Boston (area 457 sq. mi.; pop. 1930, 1,955,168).

**Streets and Buildings.** Boston is one of the oldest communities in the United States, a fact attested by its many winding, narrow streets. In modern times the task of straightening the old colonial streets has been complicated by the rolling terrain and the uneven character of the outlines of the city, so that parts of Boston are most confusing.

Boston has 639.75 mi. of streets. Washington Street, the main artery in the downtown section, is an extremely narrow business thoroughfare. The other important arteries are fashionable Beacon Street (*see* BEACON HILL), extending from Tremont Street past Boston Common in a southwest direction to Brookline and beyond; Commonwealth Avenue, 240 ft. wide, beginning at the Public Garden behind Boston Common and running parallel to the Charles River as far as Brookline, where it turns southwest to enter Brighton; and Tremont Street, extending from Scollay Square southwest into Roxbury.



Boston's historic buildings include FANEUIL HALL, dating from 1762; the State House, to which wings were added, 1914-17, on top of Beacon Hill, containing paintings and memorials; the Old State House, built in 1748, seat of the royal government of Massachusetts; Christ Church, dating from 1723, on Copp's Hill, from the spire of which lanterns were hung to warn Paul Revere of the British advance on Concord; and the Old South Meeting House, erected in 1729. Noteworthy modern buildings include the granite Custom House, with a 500-ft. tower which dominates the city; the new Federal Building on Post-Office Square; the Public Library, fronting on Copley Square, a structure in the Italian Renaissance style, considered one of the greatest libraries of the world; and the classic Museum of Fine Arts on upper Huntington Avenue. Under the building restrictions, structures in the business district may not exceed 155 ft. in height.

**Parks and Monuments.** Boston has 24 large parks and 52 separate playgrounds, with a total area of 2,647.33 acres. In the heart of the city is the celebrated Boston Common, covering 48 acres, and the Public Garden, with an area of 24 acres. Commonwealth Avenue from Arlington Street to the Newton line is a parkway of 112.70 acres; the beautiful Back Bay Fens, between Roxbury and Brookline, extending from Beacon Street to Brookline Avenue, covers 116.99 acres. The Arnold Arboretum is 223 acres in extent, and Franklin Park and Zoological Garden is 527 acres. The celebrated plazas include Copley Square, between Huntington Avenue, Boylston and Dartmouth streets, Peabody Square and Pemberton Square, on which the Court House fronts. Outside the city proper, and under control of the state, are Middlesex Fells Reservation, with 2,153 acres of natural woodlands, to the north, and Blue Hills Reservations, containing 4,907 acres, to the south.

Boston is dotted with monuments, evidences of its historic past. The first in interest is BUNKER HILL MONUMENT on the old redoubt, a granite obelisk 220 ft. high. The old frigate *Constitution* had for many years been lying in the Charlestown Navy Yard, but in 1931, on occasion of the Sesquicentennial Celebration of the surrender of Cornwallis, the ship was reconditioned and sent to Yorktown to take part in the celebration; it no longer is permanently stationed at any port. The Shaw Monument, by Saint-Gaudens, and the First Independence Monument, by Bulfinch, erected in 1790, are of special interest. Scattered throughout the city are statues of American national heroes and historical figures.

**Transportation.** Boston is a terminal of the Boston and Albany, the New Haven and the Boston and Maine railroads. The city operates Boston Airport. Water transportation for passenger and freight traffic is afforded by ships sailing regularly to Europe, the Far East, South America and Australia. Inside the city, transportation is carried on by the city-owned subway, begun in 1895, by elevated and street railway systems and by a network of bus lines.

**Commerce and Industry.** The protection afforded by Boston Harbor, and the excellent dock facilities along its 40 mi. of berthing space, have brought the city an enormous shipping traffic, exceeded only by New York. In 1929 exports amounted to \$40,762,226 and imports to \$290,394,389. The government drydock at South Boston is the largest in the western hemisphere. Because Boston was early a seaport it received a majority of raw materials and thus developed manufacturing. The leading industrial commodities are boots and shoes, printed and published material, clothing, confectionery, foundry and machine shop products, bread and other bakery products and electrical machinery. In 1929 the manufactures were valued approximately at \$600,000,000; the retail trade amounted to \$685,755,476; the wholesale trade proper, to \$1,349,717,704. In 1929 Boston, together with Suffolk Co., had a wholesale trade, all establishments, valued approximately at \$2,409,048,248. Boston is the largest wool market in the nation and the shoe and leather center of the world.

**Educational Institutions.** Among the institutions of learning are Boston University, Northeastern University, Simmons College, the Emerson College of Oratory, and the following divisions of Harvard University: the schools of medicine, dentistry and public health, the graduate school of business administration, the Bussey institution for graduate work and research in applied biology, and the Arnold Arboretum, a botanical garden. In Cambridge, across the Charles, are Harvard University, Radcliffe College and Massachusetts Institute of Technology.

**History.** Although some historians agree that the early Norsemen probably visited the site of Boston, there was no settlement, however, until 1630 when JOHN WINTHROP established his Puritan colony on Shawmut, the Indian name for the peninsula dominated by Beacon Hill. The settlers named the town Boston after the Lincolnshire seaport of England. In 1632 Boston became the capital of Massachusetts Bay Colony. The uprising in 1765 against the STAMP ACT marked the disintegration of British control. Upon the outbreak of hostilities in 1775, the British laid siege to Boston, defeating the colonials at Bunker Hill (*see* BUNKER HILL, BATTLE OF) on June 17, 1775, but were forced to evacuate the town the next year. In 1822 Boston received its city charter. In the twenty years before the Civil War, Boston was a center for Abolitionist sentiment. (*See* ABOLITIONISTS.) In 1872 65 acres of the business district were destroyed by fire, at a loss of \$75,000,000. *See also* UNITED STATES, HISTORY OF.

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**BOSTON COLLEGE**, a Jesuit college for men, chartered in 1863. A preparatory school occupies the original college site within the city of Boston, the other departments having been transferred to Chestnut Hill in 1913. The collegiate studies include arts, sciences, education and law, besides graduate, extension and summer school courses. The college

has a library of 115,000 volumes. There were in 1930 2,715 students and a faculty of 77 under the presidency of the Rev. JAMES H. DOLAN.

**BOSTON FERN**, a hardy, highly decorative plant, with drooping, dark-green foliage. It is a variety (*bostoniensis*) of the tropical sword fern (*Nephrolepis exaltata*) developed in cultivation and named by British botanists at Kew in honor of the city of Boston, Mass., near which it was discovered in 1895 by F. C. Becker. It has become one of the most highly prized ferns, growing vigorously indoors in the North and thriving well out of doors in the South.

**BOSTON IVY** (*Parthenocissus tricuspidata*), a hardy high climbing vine of the grape family, called also Japanese ivy, native to eastern Asia and widely grown as an ornamental. It is closely related to the VIRGINIA CREEPER from which it is distinguished by its more lustrous leaves divided into three instead of five leaflets. It is a very useful vine, especially in cities, enduring smoke and dust well, and covering walls densely with glossy foliage.

**BOSTON MASSACRE.** The stationing of British troops in Boston, 1768, was bitterly resented by the citizens. Following several minor outbreaks, the hostility culminated on Mar. 5, 1770, when a party of seven soldiers, provoked by a crowd of men and boys who taunted them with cries of "Lobsters!" "Bloody backs!" and other epithets, fired into the crowd. Three were killed instantly, and two of the seven who were wounded died later. The infuriated citizens compelled the soldiery to withdraw from the city proper to Castle Island; and the seven soldiers, with their captain, were put on trial for murder. John Adams and Josiah Quincy represented the defendants, five of whom were acquitted and two sentenced for manslaughter. The significance of the Boston Massacre lies not in the actual shootings but in the emotional furore they created.

**BOSTON MUSEUM OF FINE ARTS**, a public museum in Boston, Mass., which contains one of the finest art collections in America. These include original works of art of Egypt, Greece, Rome, the Orient, and modern Europe and America, supplemented by others. The museum was founded in 1870 for collecting, preserving and exhibiting works of art and of affording instruction in the fine arts. The present building was completed and opened in 1909. The museum is supported by private donations, bequests and subscriptions. It is controlled by a board of trustees which include a representative of Harvard University, the Boston Athenaeum, the Massachusetts Institute of Technology, Lowell Institute and the City of Boston.

The gallery is arranged in a series of beautiful rooms which house the various collections. These include the departments of prints, Classical art, Chinese and Japanese art, Egyptian art, Western art, and paintings, the section of Indian art, and the Library. The latter, the William Morris Hunt Memorial Library, contains the collection of books gathered by the museum since 1890. Prominent among its collection of early Ameri-

can paintings are the Gilbert Stuart portraits of George and Martha Washington. The print collection is the finest in America, and the section on Oriental art is particularly noteworthy. The museum cooperates with the neighboring colleges and universities in the instruction offered by the commission on extension courses. Lectures are given in the museum, and the galleries and classrooms are offered for work in connection with courses relating to its exhibits.

**BOSTON PORT BILL**, an Act of Parliament, Mar. 1774, designed to punish the people of Boston for their participation in the BOSTON TEA PARTY. The port of Boston was closed to commerce until the city should indemnify the owners of the destroyed tea and award damages to customs officers injured by rioters. The seat of government was to be removed from Boston to Salem. Assurances of sympathy and aid were sent to Boston by the legislatures and Committees of Correspondence of other colonies; and June 1, the date when the Port Bill became effective, was widely observed by fasting and prayer. The intense resentment of the American colonies to this bill and the other INTOLERABLE ACTS passed in the same year led to the calling of a CONTINENTAL CONGRESS to devise measures of relief.

**BOSTON TEA PARTY.** Because of the tax upon tea, which the American colonies resented as an application of the hated principle of "taxation without representation," and which materially advanced the price of the article, Americans were smuggling their tea from Holland. To assist the English East India Co., in distress because of the loss of American trade, Parliament allowed a remission of all duties except the tax in America. To prevent this cheaper tea from being sold in the colonies, a mob of Bostonians disguised as Indians proceeded to the wharf and threw the cargoes of three ships, 340 chests of East India Co. tea, into the harbor, on Dec. 16, 1773. In retaliation the Parliament and King of England enacted the BOSTON PORT BILL.

**BOSTON UNIVERSITY**, at Boston, Mass., a system of allied schools and colleges established by members of the Methodist Episcopal Church and chartered by the Commonwealth of Massachusetts in 1869. It is a coeducational institution and privately controlled. Isaac Rich was Boston University's chief benefactor, and numerous free scholarships have been established in his honor. The institution in 1931 had productive funds amounting to \$4,418,963. The library contains 145,472 volumes. In 1930 there were 14,611 students, and a faculty of 521 headed by Pres. DANIEL L. MARSH.

**BOSWELL, JAMES** (1740-95), biographer of SAMUEL JOHNSON, was born Oct. 29, 1740, in Ayrshire, Scotland. He studied law at the University of Edinburgh, but preferred a literary career. On May 16, 1763, he was introduced to Dr. Johnson and a lifelong friendship began; while the two were together Boswell kept an exact journal of Johnson's every act and word. Under threat of disinheritance, Boswell went to Utrecht to continue his law studies, and then

toured Europe, securing interviews with Voltaire, Rousseau, and the Corsican patriot, Paoli, and writing full accounts of each. His *Account of Corsica, Memoirs of Pascal Paoli, and a Journal of a Tour to the Island* was published in 1768. He was admitted to the Scottish bar in 1766, but continued to spend much time in London until Johnson's death in 1784. Two years after Johnson's death Boswell published his *Journal of a Tour to the Hebrides*. Retiring to Auchinlech, his estate in Ayrshire, he then produced the most famous biography ever written, *The Life of Samuel Johnson*, published in 1791. This work owes its fame and its position as a classic among biographies, not to Boswell's wit, invention or charm as a writer, but to his complete knowledge of the subject, his keen and tireless observation and his rigorous accuracy. Boswell was at work on a third edition of the *Life* when he died, in London, May 19, 1795.

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**BOTANIC GARDEN**, an institution for the growth, display and study of plants. Historically botanic gardens were usually confined to medicinal or at least economic plants, although the first recorded one, of Aristotle, was devoted to nearly pure research.

The modern botanic garden is a combination of living collections of plants and botanical research. The space needed for the first restricts this activity in many of the European gardens, but some of them, notably at Berlin, London and Gothenburg have magnificent plantations. There may be special horticultural developments as those of the famous garden at Kew, the geographical garden at Berlin or the succulent collection at La Mortola. In most botanic gardens there is a labelled collection of living plants arranged in systematic order in addition to the special collections. These systematic collections may number thousands of species, especially at such tropical gardens as at Rio de Janeiro and Buitenzorg, Java, the latter the most famous tropical garden in the world.

The research work at botanic gardens embraces all phases of botany. All the older ones specialized upon systematic botany and some, notably at Kew, have issued long series of monographs and floras. Other problems of botanical research, in more recent times, have been undertaken by botanic gardens, especially ecology, geographical distribution, plant physiology, plant pathology and genetics or plant breeding.

While most large European cities have botanic gardens, they are rare in the United States. Two of the most important are the New York Botanical Garden in Bronx Park and the Missouri Botanical Garden at St. Louis.

**BOTANY** is the science of plant life. The word is from the Greek, *botane*, grass or fodder, from the same root as the verb meaning to graze or feed. This indicates the origin of the science as a study of plants as articles of food for man and beast. The science is also called *Phytology*. It is one of the biological sciences which include zoology, medicine, bacteriology,

etc. As biology attempts to answer the question, What is life? so botany endeavors to answer the question, What is a plant? It embraces everything concerning plants, including their form, classification, structure, functions, distribution, relation to environment, uses, and diseases.

**Structural Botany.** This division, called also plant morphology, includes the study of External Morphology, Anatomy, Histology, and Cytology. *External Morphology* is concerned with the study of the various organs of the plant body, such as root, shoot (main stem or stems and branches), leaves, surface outgrowths (hairs, thorns), flowers and their parts, fruits, seeds, and the various modifications and disguises under which these may appear. An important problem is correctly to interpret the morphological nature of organs no matter how this may be disguised. Leaves may masquerade as stems and stems as leaves. Thorns may be modified stems, or leaf-stalks, or mere surface outgrowths. Structures which perform the same function and often closely resemble each other, but which are morphologically quite different things, are *analogous*; e.g., tendrils, used for climbing, may be modified roots, stems, or leaves. Any given organ may perform quite different functions and be modified accordingly. Thus branches may, as commonly, bear foliage leaves, or be disguised as thorns, tendrils, or flowers, which are modified branches. Organs which are morphologically the same, no matter what their appearance or function, are *homologous*. The study of abnormal morphology is *Teratology*. Thus, in the green rose all the petals resemble the leaflets of foliage leaves.

Organs are composed of tissues. The study of internal organs and tissues, requiring dissection, is *Anatomy*.

*Histology*, the study of the finer or cellular structure of tissues, is also called *Cellular Anatomy*. The study of the cells themselves, their structure and functions, is *Cytology*, which includes the study of the structure, physics, chemistry, and functions of matter in the living state (*Protoplasm*).

**Systematic Botany.** The number of different kinds of plants is so great (approximately 140,000 flowering plants and 3,800 ferns) that they must be classified before we can comprehend the plant world. This requires accurate description (*Phytography*) and comparison (*Comparative Morphology*). These studies result in the assignment of plants to related groups, systematically arranged (*Systematic Botany*). The principles of classification constitute the science of *Taxonomy*. One of these principles is that significant morphological characters and homologies, and not superficial or accidental resemblances or analogies should form the basis of classification. Related to this is the principle that the groups and their sequence should, as far as possible, indicate the evolutionary development of the plant kingdom.

In systematic literature plants may be described either by systematic groups, as, *The Genus Iris*, or by geographic distribution, as, *Rocky Mountain Flora*.

This literature contains also innumerable local floras, as *Flora of Miami*, *Flora Londinensis*.

**Systematic Groups.** The vegetation of the earth constitutes the *Plant Kingdom*, as distinguished from the animal kingdom. By considering a progressively larger and larger number of points of likenesses and differences plants are classified in a series of groups possessing a progressively smaller number of kinds. Considering only one point, we may reason that all plants either have seeds or they do not have seeds. Those having seeds constitute the division *Spermatophyta* (seed-bearing plants). Taking two characters, those bearing seeds either have their seeds enclosed or not enclosed. The former comprise the Sub-Division *Angiospermæ*, the latter, *Gymnospermæ*. By this method of inclusion and exclusion of characters, the following *taxonomic groups* have been defined:

- Kingdom—*Plantæ* (plants)
- Division—*Spermatophyta* (plants that bear seeds)
- Sub-Division—*Angiospermæ* (seeds enclosed)
- Class—*Dicotyledones* (seeds with two cotyledons)
- Sub-Class—*Sympetalæ* (petals united)
- Order—*Campanulales* (corolla bell-shaped)
- Family—*Compositæ* (flowers in a head)
- Tribe—*Anthemideæ* (pappus a short crown or none)
- Genus—*Chrysanthemum* (Golden flower)
- Species—*coronarium* (Crown daisy)
- Variety—*spatiosum* (leaves broad)

Some botanists recognize sub-order, sub-family, sub-tribe, sub-genus, and sub-species. The term species is variously defined by different botanists, some even holding that a species has no objective reality, the term representing only a concept. Horticulturists use the term variety to designate forms produced by artificial breeding. It should be kept in mind that all these terms are group-names, applying not to individuals but to populations.

**Nomenclature.** The scientific or botanical names of plants and of taxonomic groups are always in Latin. The reason for this is twofold: 1. Latin gives a uniform nomenclature, understood in all countries. If botanists of each country named their plants in their native language the names would either not be understood at all in other countries, or more or less uncertainty would exist. 2. Common or "folk" names of plants are inexact or misleading as well as varying from country to country. Thus rose, rock rose, rose of Sharon indicate plants of three different and unrelated families. By designating these plants as *Rosa*, *Helianthemum*, and *Hibiscus* accuracy and international understanding are secured, whatever one's native tongue may be.

Nomenclature is a difficult and complicated subject. Through ignorance, often unavoidable, of existing botanical literature one botanist may give a name to a plant previously named differently, thus introducing a *synonym*. Two different botanists may, unknown to each other, give the same name to different plants

(*homonyms*). Questions of *priority* arise with both synonyms and homonyms, and otherwise. When a group is revised, as when the pears (*Pyrus*) were segregated from the apples (*Malus*), problems of nomenclature arise.

From time to time since the beginning of the 20th century (Paris, 1900; Vienna, 1905; Brussels, 1910; Ithaca, 1926; Cambridge, 1930) international botanical congresses have been held at which, among other matters, endeavors have been made to secure international uniformity in nomenclature. The Fifth International Botanical Congress achieved a fuller measure of success in this than had any preceding congress. The terminations of the group-names have been standardized and are the same in nearly all countries, and other rules have been adopted with reference to priority, synonyms, homonyms, spelling, names to be arbitrarily conserved (*nomina conservanda*) and other matters.

**Plant Physiology.** This embraces the study of the life processes or *functions* of the various organs, tissues, and cells. While it requires a knowledge of anatomy, physics, and chemistry, it has its own peculiar problems. In other words, it is not merely applied physics and chemistry.

Among the problems of plant physiology are the following: The absorption and distribution of water with *mineral nutrients* and other substances dissolved in it. The elimination of water which has served for the distribution of dissolved substances throughout the plant body. This is accomplished chiefly by the process of *Transpiration*.

*Photosynthesis*, the series of processes, not fully understood, by which, in green tissue containing leaf-green or *chlorophyll* the chemical compounds, carbon dioxide (entering largely through stomata from the air), and water (entering chiefly from the soil through the roots) are, by the energy of sunlight, separated into their elements (carbon, oxygen, and hydrogen) and these elements recombined into a form of sugar.

*Respiration*, the process by which oxygen, entering the plant by gaseous diffusion or dissolved in water, combines with oxidizable substances, thereby releasing the energy necessary for the other life-processes.

*Nutrition*, the series of processes by which sugar and other organic substances, elaborated by photosynthesis and otherwise, are *digested* and *assimilated* or transformed into new protoplasm required for *growth*, and to replace the protoplasm used up in motion and locomotion, in the making of cell-walls and secreted substances such as essential oils, and in other life-processes.

**Ecology.** This is, literally, the science of the home life of plants. This branch of botany is a study of plants in relation to each other and to other factors of their environment, as light, water, gravity, temperature, soil, and air. In its broader aspects it is concerned with *vegetation* (as distinguished from individual plants), with groups of plants known as *plant-formations*, their development, distribution, and sequence in any given locality (*Succession*).

**Plant Geography.** This branch of botany, called also *Phytogeography*, is concerned with the distribution of plants over the earth's surface, and the causes which determine and accomplish this, as by seed-distribution.

**Economic Botany** is concerned with plants and plant products of use to man, including wild plants of economic value for timber, medicine, food, beverage, rubber, and fodder.

**Genetics** is the "pure science" of heredity and variation. Often included with it is the "applied science" of *Plant Breeding*, called also applied genetics or *eugenics*, the artificial production of new and improved varieties of economic plants.

**Phytopathology** is the study of plant diseases, their causes and control or cure. The results of this study are of the highest importance in agriculture, horticulture, and floriculture.

**Palæobotany** is the study of the fossil remains of plants of previous geological ages, yielding data of importance in determining the relationship of modern plant groups, and in the study of past climates and the relative age of various rock strata. C. S. G.

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**BOTANY BAY**, an inlet on the coast of New South Wales, Australia, first entered by Captain Cook in 1770. Beginning with 1787 a penal colony was maintained for some years on its shores, now a part of the suburbs of Sydney.

**BOTFLY**, any insect of the families *Æstridæ* or *Gastrophilidæ*. The larvæ are parasitic on mammals. The adults are bee-like, mostly larger than

bot which attacks horses belongs to the family *Gastrophilidæ*, to which the chin fly or throat-bot, and the red-tailed botfly or nose-fly, both of which attack horses, also belong. Other mammals attacked by botflies are rabbits, deer, reindeer, chipmunks, squirrels and sometimes even man. See SHEEP-BOT; HORSE BOTFLY; OX-WARBLE.

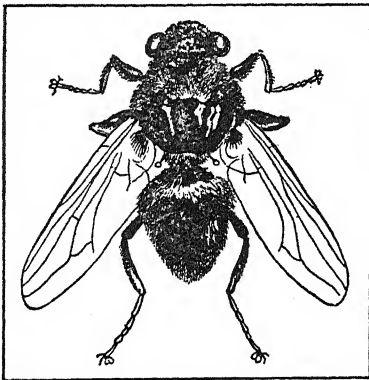
**BOTHA, LOUIS** (1862-1919), Boer general, was born near Greytown, Natal, Sept. 27, 1862. His military skill won recognition in the BOER WAR when he succeeded Joubert as Commander of the Transvaal forces. In 1907 he became the first Prime Minister of the Transvaal Colony, and in 1910 the first Premier of the Union of South Africa. At the outbreak of the World War Botha brought South Africa into the conflict on the side of Great Britain. In 1914-15 he conquered German Southwest Africa. He was a delegate to the Paris Peace Conference in 1919 and died at his farm in the Transvaal that same year, Aug. 28.

**BOTOSANI**, capital of the Rumanian district of the same name, in northern Moldavia, built on the River Tijia, about 60 mi. northwest of Jassy. It is the center of a rich wheat district with a brisk trade in grain and has several large flour mills. Pop. 1930, 32,197.

**BO TREE**, one of the names given to the peepul, a species of FIG (*Ficus religiosa*), sacred to Buddha, the most highly venerated tree in India where it is native.

**BOTRYTIS**, a genus of world-wide distribution belonging in the group of the *Fungi Imperfecti*. It has more than two hundred species some of which are the cause of important plant diseases. Botrytis is characterized by botryoidally branched conidiophores that bear numerous conidia. Several species have been shown to possess sexual or perfect stages that are referable to the genus *Sclerotinia*. Although weakly parasitic its species attack the fruits, flowers, stems and leaves of a large number of different plants including many that are of economic importance. New hosts are frequently reported and it is probable that its species will eventually be shown to parasitize many plants that are not now known to be susceptible. They are, perhaps, best known to gardeners and florists as the cause of blights in such flowers as geraniums, lilies, cyclamens, dahlias, carnations, asters, roses, tulips and peonies. Species of Botrytis cause leaf spot diseases, twig blights and stem rots. They are the common gray molds that occur on blighted blossoms and twigs during rainy periods in summer. Because of their wide host ranges, the ease with which they are cultivated on artificial media, their sensitiveness to environmental conditions and the varying degrees of parasitism shown, the species of Botrytis have been favorite subjects for physiological work and for the study of host and parasite relationships. L. O. K.

**BOTTA, CARLO GIUSEPPE GUGLIELMO** (1766-1837), Italian statesman and historian, was born at San Giorgio del Canavese, in Piedmont, Nov. 6, 1766. Sympathy with the French revolutionists cost



BOTFLY  
Enlarged

house flies, with mouthparts usually vestigial. To the family *Æstridæ* belong the sheep botfly, the ox-warble flies, the bomb-fly and the heel-fly. All but the first-mentioned species attack cattle. The stomach



him two years in prison, but in 1794 he enlisted as a doctor in Napoleon's expedition to Corfu. Elected a member of the Piedmont provisional government, he opposed Napoleon when the emperor annexed the country in 1803. Botta's later years were spent in teaching history; his chief work is the *Storia d'Italia dal 1789 al 1814*. He wrote *History of the American War of Independence*. He died at Paris, Aug. 10, 1837.

**BOTTICELLI, ALESSANDRO** or **SANDRO** (1444-1510), Italian painter, whose real name was Alessandro di Mariano dei Filipepi, was born at Florence in 1444, the son of a tanner. A pupil of the painter Fra Filippo Lippi, he became one of the foremost Florentine artists of the early Renaissance. He was sponsored by the house of Medici, and his talent was skilfully directed. The *Primavera*, now in the Uffizi Gallery at Florence, was one of Botticelli's first paintings for his patrons. In 1481 Sixtus IV summoned him, among other artists, to decorate the new Vatican chapel, now the Sistine, where he painted three frescoes. About 1483 he received commissions in Florence from the Medici and other families. His best known canvases are *Adoration of the Magi*, in the National Gallery, London, *Birth of Venus*, in the Uffizi, and *Saint Sebastian*, in the Church of Santa Maria Maggiore, Florence. Also notable is the series of drawings for Dante's *Divine Comedy*. Botticelli died at Florence, May 17, 1510.

**BOTTLE**, a narrow-necked vessel for containing liquids. Various materials are used in making these vessels, but they are ordinarily of glass. The ancients used bottles made from skins, stone, pottery, ivory, bone, and metal (bronze, silver and gold). Skin bottles are still used in Eastern Europe for containing wine. Bottles are among the oldest glass articles recorded in history. Specimens found in Egyptian tombs date back over 5,000 years.

The glass used in bottles is, in general, composed of the oxides of silicon, sodium and calcium. Other oxides may be present and the proportions of the various materials may be varied according to the particular type of glass desired. These materials are melted in furnaces and formed into bottles by the hand blowing or by semi-automatic or fully automatic machine blowing, machine methods being used for all ordinary industrial purposes.

After the introduction of the iron blow pipe (about the beginning of the Christian Era) glass was gathered from a pot in which it had been melted, and the bubble, formed by blowing, was shaped by hand. During the 8th century a method was introduced in which the bubble was blown into a mold which formed the bottle. This was afterwards cracked from the pipe, and the neck shaped separately.

Modern bottle manufacture dates from the invention of Michael Owens, an American. He melted the glass in large tanks at about 2500° F., using sand, limestone, soda ash and other chemicals. The molten glass was mechanically sucked into a form. This form shaped the neck, which was then held by a groove in a blow mold and the rest of the mass

blown into a bubble and shaped to form the finished bottle.

There have been numerous modifications of this process. In one of these, the glass flows from a spout and drops in sausage shaped masses into molds where it is shaped and blown. The bottles are afterwards sent through an annealing oven to remove strains that might cause them to break. Some modern machines are able to produce six to eight bottles per second. Sizes vary from the tiny sample vial to twenty-gallon demijohns, and the quality varies from that of the ordinary milk or beverage bottle to the finer compositions of fancy perfume bottles. A. S.

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**BOTTLE TREE** (*Sterculia rupestris*), a peculiar tree of the sterculia family, native to Australia and occasionally grown for ornament in warm countries. It takes its name from the barrel-like expansion of the trunk, giving it somewhat the appearance of an immense bottle, the spreading limbs appearing to grow from its mouth. The inflated trunks are hollow and enclose a supply of water which travelers in need obtain by cutting through the light soft wood. The stem contains a mucilaginous substance resembling gum tragacanth, sometimes used for food by the aborigines, who also make nets of its fibers.

**BOTTOMRY**, a term meaning the obtaining of a loan by mortgaging a ship, the word coming from the keel or bottom of the ship. It differs from ordinary mortgages in several respects. The contracting parties may agree on larger rates of interest than the law allows on land property. The lender assumes the risks during the voyage for which the money is loaned. Not only the owner, but, in foreign ports, the captain has the right to borrow, and if the captain should die, the first mate may borrow providing no owner can be reached.

**BOTULISM.** See **FOOD POISONING**.

**BOUCICAULT, DION** (1822-90), Irish-American actor and playwright, was born at Dublin, Ireland, Dec. 26, 1822. After a brief period of study at London University he determined to become an actor and during 1837-40 toured the English provinces. His first successful dramatic piece was *London Assurance*, produced at London in 1841. During 1848-52 he made a series of adaptations from the French for CHARLES KEAN, and in 1853 took passage for the United States. In America Boucicault wrote *The Poor of New York*, produced in 1857, *Jessie Brown*, 1858, *The Octoroon*, an immensely successful play on the slavery theme, produced in 1859, and, among others in the Irish vein, *The Colleen Bawn*, 1860, *Arrah-na-Pogue*, 1864, *The O'Dowd*, 1873, and *The Shaughraun*, 1874. JOSEPH JEFFERSON appeared with varying success in a number of Boucicault's plays, which totaled more than 130, including adaptations. Boucicault died at New York City, Sept. 18, 1890. In 1928 his better known plays were revived by the Hoboken (N.J.) Theatrical Company.

**BOUGHTON, GEORGE HENRY** (1834-1905), English painter, was born at Norwich, England, Dec. 4, 1834. He came to America when a child and studied art in New York, Paris and London. His pictures are mostly representations of the lives of early American colonists and are notable for a fine sense of color. They include *The Return of the Mayflower*, *Evangeline*, *Puritans Going to Church* and *The Scarlet Letter*. Boughton was associated in 1879-91 with the Royal Academy, London, and died in London, Jan. 19, 1905.

**BOUGUEREAU, ADOLPHE WILLIAM** (1825-1905), French painter, was born at La Rochelle, Nov. 30, 1825. His art education began in Paris, where he won the Prix de Rome in 1850 enabling him to continue his studies in Italy. Four years later his *Body of St. Cecilia Borne to the Catacombs* was a leading attraction at the Paris Salon and was subsequently hung in the Luxembourg Museum. Bouguereau's later pictures, now distributed in European and American galleries, include a few portraits but are mostly religious subjects. The painter died at La Rochelle, Aug. 18, 1905.

**BOULDER**, a city in eastern Colorado, county seat of Boulder Co., 29 mi. north of Denver. It is served by the Union Pacific and the Colorado and Southern railroads. The chief interests of the countryside are mining, stock breeding and farming; the industries include brick works and the manufacture of food products and cutlery. In 1929 the total manufactures were approximately \$800,000; the retail trade amounted to \$7,533,078. Oil has recently been discovered, and nearby are gold, silver, tungsten and coal mines. The city owns the Arapahoe glacier from which it derives its water supply. The famous Boulder Cañon and the Rocky Mountain scenery attract many summer tourists. Boulder is the seat of the state university. Pop. 1920, 11,006; 1930, 11,223.

**BOULDER CLAY**, called also till and hardpan, an unsorted mixture of boulders, gravel, sand and clay left by melting glaciers. Ice, in the form of moving glaciers scraping over the rocks and ground, picks up such material which remains frozen in it or, riding on top, is indiscriminately dropped when the ice melts. *See also* MORAINES; GLACIATION; GLACIAL PERIOD; GLACIER; ICE AGE; INTERGLACIAL STAGES.

**BOULE**, a select council of elders at Athens, Greece, whose number varied greatly in different times. Members had to be over 30 years old, chosen by lot, and were subjected to account at the end of each year. The main council was divided into sections, some one of which was in session every day. Among its functions were those of war, finance, law-making, the permanent affairs of state, matters affecting the allies, supervision of temples, arsenals, certain judicial functions, religious ceremonies and the preparation of matters to be referred to the assembly of the people for vote. *See also* ATHENIAN CONSTITUTION.

**BOULOGNE, CONFERENCE OF**, June 21-22, 1920, one of a series of Allied meetings preliminary

to the settling of the total German reparations, following the WORLD WAR. The conference was held at Boulogne, France, and attended by representatives of France, Great Britain, Greece, Italy, Japan and Belgium. Delegates disagreed over the size of the indemnity, but drafted a Boulogne agreement, as an alternative settlement in case the Germans proposed paying too small an indemnity. The chief positive result of the meeting was the approval of the Franco-Italian reprisals against the Turkish Nationalists.

**BOULOGNE-BILLANCOURT** or **BOULOGNE-SUR-SEINE**, a southwestern suburb of Paris, skirting one side of the Bois de Boulogne, on the right bank of the Seine, department of Seine. It has extensive industries, including laundering, and a large and handsome residence quarter, with a Gothic church of the 14th and 15th centuries. The name Boulogne-Billancourt was established by decree in 1925. Pop. 1931, 86,234.

**BOULOGNE-SUR-MER**, a city and seaport in the department of Pas-de-Calais, northern France, situated at the mouth of the Liane River on the English Channel, 156 mi. northwest of Paris. In addition to general export and import trade, Boulogne is a busy center for passenger traffic with England and for North Sea fisheries, and is a port of call for transatlantic liners. It is also a watering-place. Steel pens are its chief manufacture. The modern Lower Town is quite distinct from the quiet Upper Town, which still keeps its 13th century walls. Napoleon I massed at Boulogne the army with which he hoped to invade England. During the World War American troops disembarked here. Pop. 1931, 51,854.

**BOUNCING BET**, the name widely given in the United States to the common SOAPWORT (*Saponaria officinalis*) of the Old World, long cultivated as a garden flower and widely naturalized in North America as a weed.

**BOUNDARIES**, limits, natural and artificial, to the territory of a state, and to the jurisdiction exercised over that territory. As territory and jurisdiction are coextensive, the exercise of SOVEREIGNTY cannot be carried beyond the territorial limits of the state. Natural and geographical conditions may form the boundary line, or it may be arbitrarily formed by treaty (*see* TREATIES.) Different rules apply to different natural boundaries. In case of mountains and hills forming the boundary, it follows the water divide. Where a river is navigable, the principle of the thalweg, or the middle of the navigable channel, determines the frontier. Where a lake forms the boundary, the middle of the lake is the frontier, in the absence of a treaty.

**BOUND BROOK**, a borough of Somerset Co., N.J., on the Raritan River and the Delaware and Raritan Canal, 28 mi. southwest of Jersey City. It is an important junction point of the Reading and the Central of New Jersey railroads and is also served by the Lehigh Valley Railroad. Its varied manufactures include roofing materials, motion picture film,

chemicals and paints. Near the town are located the radio transmitting station WJZ and large commercial greenhouses devoted to orchid production. Bound Brook was the scene of fighting during the Revolution and it is said that while Washington was encamped on Middlebrook Heights near the village the banner containing the stars and stripes was unfurled as the national flag for the first time, June 17, 1777. Bound Brook was incorporated as a borough in 1891. Pop. 1920, 5,906; 1930, 7,372.

**BOUNTY**, a term used to describe the payment by the state of a certain amount per unit of an article. The purpose of such payment is to promote and stimulate some particular activity in connection with the object on account of which the bounty is paid. Thus, a bounty may be paid to encourage the production, importation or exportation of a commodity. The states which have had difficulty with predatory animals have often paid bounties on scalps or tails of Wolves, Coyotes, Rats and other vermin, as a stimulus to hunters and trappers.

During the years 1890 to 1894, while foreign SUGAR was on the free list, the United States paid a bounty of two cents per pound on sugar produced within the country. Various foreign countries have paid bounties on the export of sugar and other articles. Import bounties, once a feature of Great Britain's policy of stimulating trade with the colonies, have not been retained in modern commercial policy.

The bounty on domestic production is similar, in its effect on domestic and foreign competition, to a duty on imports. The import duty (*see* CUSTOMS DUTIES) causes the price within the country to rise by substantially the amount of the duty, thus giving the domestic producer an advantage in the home market. He receives the same comparative advantage if he is paid a bounty on his output while the imported article is admitted free of duty. H. L. L.

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**BOURBON, CHARLES, DUKE OF BOURBONNAIS** (1490-1527), French general, was born Feb. 17, 1490. Francis I made him "Constable de Bourbon" at the age of 26. He was well liked while viceroy of Milan, until Francis conveniently banished him. Stung by this treachery, he offered his services to Charles V of Spain who provided him with an army. In 1523 the Constable, wary of treachery, refused a reconciliation with Francis, and soon after he helped defeat the French king at Pavia. With a large following he returned to Milan, and was virtual ruler of northern Italy. In 1527 his army laid siege to Rome, where Charles, leading the attack, was killed May 6, 1527, by a ball fired, according to some accounts, by Benvenuto Cellini.

**BOURBON**, island. *See* RÉUNION.

**BOURBON HOUSE**, a royal family of France, which also ruled in Spain, the Sicilies, and the duchies of Lucca, Parma and Piacenza, as well as Naples. Although the family may be traced back to the 14th century, it was not until Henry of Navarre ascended

the throne as Henry IV in 1589 that the house came into power in France. Henry's father was a Bourbon, and from his mother he inherited Navarre, thus joining the two lines. Upon the assassination of Henry III in 1589, the House of Valois gave way to that of Bourbon. The Bourbons ruled in France uninterruptedly until the time of the French Revolution in 1792, when Louis XVI and his queen, Marie Antoinette, went to the guillotine. The most famous of the line was Louis XIV (1643-1715), who was known as the Grand Monarque and whose reign was the longest in European history. The French Bourbons returned to the throne after the FRENCH REVOLUTION, from 1815-48, when they were represented first by Louis XVIII, then by Charles X, brothers of Louis XVI, and from 1830 on by Louis Philippe, a member of the Orleanist branch of the line.

In 1700 Louis XIV placed his grandson, Philip of Anjou, on the Spanish throne as Philip V. From him were descended the Spanish Bourbons the line of which came to a close in 1931 with the abdication of Alphonso XIII and the establishment of the Spanish Republic. In 1735 Philip gave to his son the kingdom of the Two Sicilies, and in 1748 the duchies of Parma and Lucca were acquired. With varying success the Bourbons held their Italian possessions until the formation of the kingdom of Italy in 1860.

**BOURDELLE, EMILE-ANTOINE** (1861-1929), French painter and sculptor, was born at Montauban, Oct. 30, 1861. He studied at the Ecole des Beaux Arts, Toulouse, at the Ecole National des Beaux Arts, Paris, and under AUGUSTE RODIN. Bourdelle has monuments in Paris, Montauban, Buenos Aires and Alsace, and works in many of the museums of Europe and America. These include *Allegorie*, *La Vierge d'Alsace*, *Heracles*, *L'Eloquence*, the monument of Gen. Alvear, and busts of Anatole France, Rodin, Krishnamurti and Dr. Koberle. Bourdelle died at Vesinet, Oct. 1, 1929.

**BOURDON GAUGE.** *See* PRESSURE GAUGES.

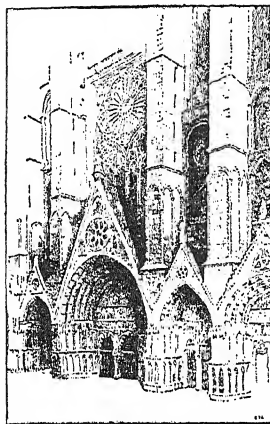
**BOURGAS.** *See* BURGAS.

**BOURGEOIS, LEON VICTOR AUGUSTE** (1851-1925), French statesman, was born at Paris, May 21, 1851. He studied law but chose a political career. He served as a director in the Ministry of the Interior and as a prefect of the police, 1886-87. In 1895 he became prime minister. In both 1899 and 1907 he headed the French delegations at The Hague Peace Conferences and was the first to suggest a league of nations. In 1920 he was awarded the Nobel prize for peace. His writings include *The Education of Democracy* and *The Compact of 1919 and the League of Nations*. He died Sept. 29, 1925.

**BOURGES**, a town in central France, famous for its rare examples of medieval architecture. The house of Jacques Coeur, built by the powerful merchant prince in 1443-51, is one of the finest existing examples of domestic Gothic architecture; it incorporated part of the city's Roman ramparts within its walls. The hotel Cujas, which houses the Musée de Barry, and the hotel Lallemand are conspicuous among

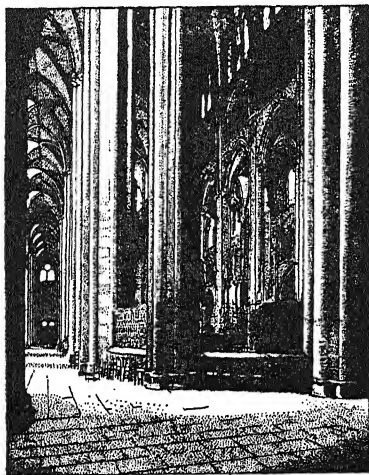
other fine old buildings. Bourges was the residence of Charles VII, mockingly called "King of Bourges," before Jeanne d'Arc came to restore him to his patrimony. It is now the capital of the department of the Cher, and a military and munitions center. Pop. 1931, 45,067.

The Cathedral of St. Étienne at Bourges is one of the noblest of Gothic cathedrals, majestic in mass and noteworthy for the great beauty of its details.



BOURGES CATHEDRAL  
West façade

It was begun in 1192 by an unknown architect who evidently followed, with adaptation, the plan of THE CATHEDRAL OF NOTRE DAME in Paris. The cathedral was consecrated in 1324. The Romanesque lateral portals, with porches, remain from a church of the 11th and 12th centuries, and there is a Romanesque crypt beneath the choir. The imposing west front, 180 ft. wide, is divided into five porches and is flanked by two towers. The more interesting north spire was built in 1508-25;



BOURGES CATHEDRAL, SHOWING INTERIOR  
FROM THE AMBULATORY

the unfinished south tower dates from the 13th century. The porches are richly adorned with sculpture, and the *Last Judgment* of the central tympanum is especially admirable. The interior, with a double aisle on each side of the nave, has a total width of 130 ft.;

13th century, probably stands second in France to that of the Cathedral of Notre Dame, at Chartres. The finest windows of the Bourges Cathedral are found in the apse and west front.

**BOURGET, PAUL CHARLES JOSEPH** (1852- ), French author, was born at Amiens, Sept. 2, 1852. In 1883 he published his *Essays* which revealed him as a profound social critic. The next year he dealt with the prevailing French pessimism in a novel, *l'Irreparable*, followed by *Un crime d'amour*, *Mensonges*, *Le disciple* and other psychological portraits of his countrymen. *Impressions of America*, 1894, described his experiences on a visit to the United States. Bourget is also the author of several plays, among them *La barricade* and *Le tribun*, which, like his novels, dealt with social problems of his day. The author was elected to the French Academy in 1894.

**BOURNE, JONATHAN, JR.** (1855- ), American legislator, was born at New Bedford, Mass., Feb. 23, 1855. Graduating from Harvard University in 1873, he shipped to the Pacific, was wrecked on Taiwan, and eventually settled at Portland, Ore., where he began reading law and was admitted to the bar in 1881. He soon abandoned law for mining and other business interests, and began his political career as a Republican member of the Oregon Legislature in 1885. He was a delegate to the Republican National Conventions of 1888 and 1892, and in the interval sat upon the Republican National Committee. In 1897 he served a third term in the Oregon Legislature and in 1907 was elected United States Senator. Bourne was an ardent progressive, advocating the referendum, recall, initiative, and direct election of Senators. While a Senator he was instrumental in securing the enactment of the parcels post law. In 1912 he participated in the organization of the Progressive Republican League. Denied renomination by the Oregon Republicans he retired to private life.

**BOURNE, RANDOLPH SILLIMAN** (1886-1918), American essayist and critic, was born May 30, 1886, at Bloomfield, N.J. His idealistic philosophy was first revealed in the essay *Youth and Life*, published in 1913, and he displayed his talent as a social critic in *Impressions of Europe*, 1913-14. He became a fervent pacifist, contributing articles to the *Masses* and the *Seven Arts*. Alone and in poverty, Bourne continued to protest against war and social conditions generally, until he died in the influenza epidemic, Dec. 22, 1918.

**BOURNEMOUTH**, a watering-place and resort of Hampshire, England, about 107 mi. southwest of London. It lies in the valley of a small stream, the Bourne, and faces upon Poole Bay. A fine beach is backed with sandstone cliffs buttressed by ridges on which the pine woods reach the shore. The town has risen rapidly from a private shooting preserve and invalid resort to its modern popularity because of its pleasant situation and climate. ROBERT LOUIS STEVENSON was one of its early invalid visitors; William Godwin and his wife Mary Wollstonecraft made it their home, and

with their daughter Mary, Shelley's second wife, are buried there. Bournemouth also is the Sandbourne of Hardy's *Tess of the d'Urbervilles*. The resort has a fine art gallery, museums, a municipal college and a broadcasting station. There are municipal concerts and golf courses, and handsome public buildings, churches, drives and parks. Pop. 1921, 95,751; 1931, 116,780.

**BOURRÉE**, a dance, in duple meter, popular among the French peasants of the 17th century. It is hardly to be distinguished in musical form from the gavotte. Like the latter it frequently lent its name to an interpolated movement in the *Surte*.

**BOURSE**, a name applied to many of the stock exchanges in Europe. The most important are those at Paris and Berlin. There are only 70 members of the Paris Bourse, and the requirements for membership are strictly regulated. Members must be of French nationality, above 25 years of age, and must have undergone a period of probation. This selected group forms the *parquet* or market, administered by the STOCK EXCHANGE committee. Besides the *parquet* there is the *marcbe en banque* or *coulisse*, which deals in securities excluded from the *parquet*; and also a *marcbe libre* or *hors côté*, comparable to the New York CURB MARKET. French securities are largely sold on credit, settlement days for the *parquet* being the 15th and the last day of each month, and for the *coulisse*, the last day of the month.

Membership in the Berlin Bourse is limited to persons approved by the administrative council. These persons are the *kursmakler*, and are either representatives of financial houses, or persons operating on their own account. Each dealer has allotted to him a group of securities, and sets the rate on each one at the opening of trading every day. Besides the *kursmakler* there are *freie makler* who are comparable in function to the dealers of the Paris *coulisse*. Trading in Berlin is carried on either for term or for account. In the former case, which is the more important, settlement is made on the last day of the month. Clearings of both types of sale are made through the Bank des Berliner Kassen-Vereins, a stock clearing-house which handles not only securities and balances at Berlin, but also clears between Berlin and other German cities where there are exchanges. See also WALL STREET.

B. H. B.

**BOUTWELL, GEORGE SEWELL** (1818-1905), American legislator, was born at Brookline, Mass., Jan. 28, 1818. He was largely self-educated, studying law while a store clerk at Groton, Mass., and rose to political prominence at a comparatively young age. After serving in the State Legislature for several years, he was elected governor of Massachusetts in 1851 and in 1852 as a Free-Soil Democrat. His strong anti-slavery sympathies caused him to enter the ranks of the Republican Party in 1855, and thereafter he consistently identified himself with its radical wing. In 1862 Lincoln made him the first commissioner of the new department of internal revenue. From 1863 to 1869 Boutwell was a representative in Congress, where

he played a leading rôle in the impeachment proceedings against President Johnson in 1868. He was chairman of the committee that drafted the articles of impeachment, and a member of the board of managers that heard the trial. He drew up and reported to Congress the 15th Amendment to the Constitution. Under Grant he served as Secretary of the Treasury 1869-73, and was United States Senator 1873-79. Resuming his legal practice, he handled numerous cases of importance involving questions of international law. In 1898 he organized the Anti-Imperialist League, serving as its first president until his death at Groton, Mass., Feb. 27, 1905. Besides his political activities, Boutwell was for several years secretary of the Massachusetts Board of Education, and was also an overseer of Harvard.

**BOVINE TUBERCULOSIS.** See TUBERCULOSIS, BOVINE.

**BOWDITCH, NATHANIEL** (1773-1838), American mathematician and astronomer, was born at Salem, Mass., Mar. 26, 1773. He learned navigation at sea, became proficient in higher mathematics, and in 1802 published the *New American Practical Navigator*, still in use by the U.S. Navy. Bowditch was also an adept linguist, and translated P. S. LAPLACE's *Mécanique*. He declined a Harvard and an Annapolis professorship. He died at Boston Mar. 16, 1838.

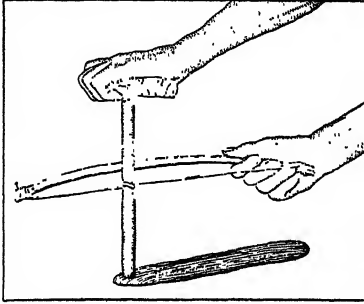
**BOWDLER, THOMAS** (1754-1825), English editor and expurgator, was born near Bath, July 11, 1754. A graduate doctor, his interest turned to literature, and in 1818 he published *The Family Shakespeare*. In this work Bowdler deleted passages he considered indiscreet; hence the verb "to bowdlerize," implying absurd expurgation. Bowdler devoted his last years to preparing a similarly genteel version of Gibbon's *Decline and Fall of the Roman Empire*. He died at Rhyddings, South Wales, Feb. 24, 1825.

**BOWDOIN COLLEGE**, a privately controlled, non-sectarian institution for men at Brunswick, Me., named for James Bowdoin, Revolutionary War Governor of Massachusetts. It was incorporated June 24, 1794, by General Court of Massachusetts, on petition of the citizens of the District of Maine, and opened in 1802. The college had productive funds of \$6,310,000, in 1931. The library of about 152,000 volumes includes the Huguenot Collection, the Longfellow Collection, and the State of Maine Collection. In the Walker Art Building there are several Stuarts and other notable early American examples, as well as some old masters. In 1931-32 there were 570 students enrolled, and the faculty of 52 was headed by Pres. Kenneth C. M. Sills.

**BOW-DRILL**, a primitive fire-making device consisting of a board of soft wood against which a pointed stick is revolved in a shallow hole by means of a string wound around the stick and attached to the ends of a bow. The stick is steadied against the chest or, as in the case of the Eskimo, held against the teeth. The bow is sawed back and forth revolving the stick and eventually producing a spark at the point of con-



tact with the board. This device is an improvement on the FIRE-DRILL as a means of producing fire. In many variations it is common among the Eskimo and among certain Indian tribes. Also known as a bow-drill is a tool for cutting and engraving gems consisting of a sharp-pointed metal drill which is



BOW-DRILL, SHOWING POSITION TAKEN  
IN MAKING FIRE

swiftly rotated by means of a bow and string. Engraving with the bow-drill was first introduced in Assyria and Babylonia about 3000 B.C. and superseded the use of a sapphire point. The bow-drill principle has been used by both primitive and civilized peoples.

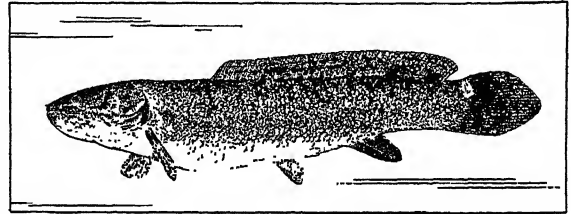
**BOWELL, SIR MACKENZIE** (1823-1917), Canadian political leader, was born in Rickingham, England, Dec. 27, 1823. In 1833 he went to Belleville, Ont., and later became owner and editor of the *Intelligencer* there. In politics he drew part of his strength from his membership in the Orange Order, of which he was for many years Grand Master for British America. His brief period as prime minister (1894-96), resulted in great dissatisfaction among his followers and half of his cabinet resigned together in 1895. He was, however, leader of the Conservatives in the Senate from 1896 to 1906, and he represented the Senate at King George's coronation in 1911. He died at Belleville, Dec. 11, 1917.

**BOWER BIRD**, the name given to several extraordinary birds which construct elaborate playhouses or courting bowers. They comprise a distinct family (*Ptilonorhynchidae*) of crow-like birds, all natives of Australia and the Papuan Islands. The best known is the satin bower bird (*Ptilorhynchus violaceus*), found in eastern Australia. The male, somewhat smaller than a crow, has velvety purplish-black plumage, while the female is grayish-green above and pale yellow and brownish below. This species, which feeds chiefly upon fruits, builds in a tree fork a bulky nest of twigs lined with eucalyptus leaves, laying two eggs with brown markings. The courting bower, constructed on the ground usually in thickets, consists of a platform of sticks or twigs in the center of which are built two parallel walls, more or less arched inward at the top, enclosing a runway or walk. This unusual structure, the entrance to which is surrounded by various decorative objects, as bits of whitened bone, highly colored fruits and brilliant feathers, is sometimes two feet long and about a foot wide and a foot high.

Among other species building remarkable courting bowers are the regent bower bird (*Sericulus melinus*), one of the most beautiful of Australian birds; Newton's bower bird (*Prionodura newtoniana*), native to Queensland, building a bower sometimes 9 ft. high; and the Gardener bower bird (*Amblyomis inornatus*) of New Guinea.

**BOWERY, THE**, a slum in New York City which has grown up around a wide avenue extending from Chatham Square to the junction of Third and Fourth Avenues. The section, originally known as the Bouwerie or Great Bouwerie (so called after the neighboring estates of Governor Peter Stuyvesant), has been the haunt of many criminals and lawless characters. Numerous tales, legends and ballads are associated with the Bowery.

**BOWFIN** (*Amia calva*), a remarkable fresh-water fish allied to the garpikes, known also as mudfish,



BOWFIN

lawyer, grindle and dogfish. Inhabiting lakes and sluggish streams, it is abundant from the Great Lakes region and the upper Mississippi Valley to Virginia, Florida and Texas. It is mottled green in color and sometimes attains a length of 2½ ft. and a weight of 12 lbs. Its peculiar air bladder, which serves as a well-developed lung, enables it to live an hour or more out of water, giving it great tenacity of life. The bowfin is of very voracious habit, preying upon other fish, crustaceans and insects. Although its ill-flavored flesh is of little value for food, the bowfin fights hard when hooked and is an excellent game fish. The bowfin is of especial interest to zoologists as the only living representative of the order *Halecomorphi*.

**BOWIE, JAMES** (1799-1836), Texas soldier, was born in Burke County, Ga., in 1799. After a youth of Indian fighting, he settled, in 1828, at San Antonio, Tex., where he joined the party resisting the Mexican government. In the hostilities against Mexico in 1835, Bowie's daring leadership helped to clear Texas of the Mexican army. His favorite weapon was a long knife, whence the type called "bowie knife." Making a stand at the old ALAMO mission, he was killed by Mexicans, Mar. 6, 1836.

**BOWLES, RICHARD PINCH** (1864- ), Canadian educator, was born near Brampton, Ontario, 1864. He graduated at Victoria University in 1885, studied theology, and in 1888 was ordained a Methodist minister. Bowles occupied pastorates in the leading churches of Toronto and Winnipeg up to 1905, when he became professor of homiletics at Victoria

University. Later he was made president and eventually became chancellor of this institution.

**BOWLES, SAMUEL** (1826-78), American journalist, was born at Springfield, Mass., Feb. 9, 1826, the son of the founder of the *Springfield Republican*. He joined the staff of that paper at an early age and succeeded his father as editor, a post he filled for more than 30 years. In the conduct of his paper Bowles set standards of journalism which won universal admiration and respect. He was one of the first editors to advocate free suffrage for white and black, and to recommend woman suffrage. Bowles died at Springfield, Jan. 16, 1878.

**BOWLING**, an indoor game played on an alley with ten pins and balls. Since 1900 this game has developed from almost obscurity to a sport which has more than 8,000,000 participants, 25 per cent being women. This game was introduced into the United States by the Dutch some 300 years ago. The Dutch set aside a place, which is now Battery Park in New York, as the official bowling green; and although bowlers disappeared from there generations ago, the section is still called Bowling Green. The game is played in Great Britain, Germany, Norway, Sweden and Finland but has reached its greatest popularity in America.

Bowling, which started as an outdoor game, was greatly handicapped by the weather; but the trouble caused by the climatic whims was ended in 1840 with the construction of the first indoor greens in New York. The original indoor greens were about 30 feet wide and much longer than the official one in use today. At first they were floored with baked clay, but later were made of slate blocks. Finally wood became the standard flooring, and the word greens was dropped and alleys substituted. There has been two-pin bowling, three-pin and later nine-pins. In the early '90s the 10th pin was added, and from that time bowling started to flourish. The American Bowling Congress was organized in 1900, and the first American Bowling Congress tournament was held in 1901, the entries consisting of 41 five-man teams, 72 two-man teams and 115 individuals. In comparison the tournaments in 1928, 1929 and 1930 have averaged more than 12,000 participants. Prize money in 1901 totaled \$25,000; the average for 1928, 1929 and 1930 was more than \$100,000.

The game is popular from coast to coast in America, and during the year a series of tournaments are held in order to select representatives from the American Bowling Congress, which is held every spring. A 300 club, for those bowlers who have registered perfect scores, also has been organized. George Rudolph of Waukegan, Ill., has been credited with the best three-game record, making scores of 279, 299 and 300, or a total of 878 and an average of  $292\frac{2}{3}$ . He made 34 out of a possible 36 strikes.

So many women have become bowling followers that the Women's International Bowling Congress was organized on Nov. 29, 1916, and their first tournament held in St. Louis in 1917. There were 8

five-women teams, 16 two-women teams and 24 individuals in that first tournament. In the 13th annual tournament at Louisville in 1930 the classic attracted entries from 354 five-women teams, 500 two-women teams and 998 individuals. Membership in the Women's Congress totaled in 1931 close to 10,000, St. Louis leading with almost 1,000. Virtually every state in the Union has representation, and in 1930 one contestant made the journey from Alaska. J. S. CA.

**BOWLING GREEN**, a city in southern Kentucky the county seat of Warren Co., situated at the head of navigation on the Barren River, about 115 mi. southwest of Louisville. The Louisville & Nashville Railroad, bus lines, three Federal highways and a steamship line afford transportation. Bowling Green is surrounded by a splendid dairying region, which also produces tobacco, corn, wheat and hay. Manufactures include rock asphalt, oil, building stone, tobacco products and evaporated milk. In 1929 the factory output reached an approximate total of \$1,000,000; the retail trade amounted to \$7,341,328. Located here are the Western Kentucky State Teachers College, Southern Normal School, the Bowling Green Business University and Bowling Green College of Commerce. Originally organized as a town in 1798, Bowling Green was incorporated as a city in 1812. Pop. 1920, 9,638; 1930, 12,348.

**BOWLING GREEN**, a city in northwestern Ohio, the county seat of Wood Co., situated 22 mi. south of Toledo. It is served by bus lines and two railroads. Oil and gas are found in this region. The principal crops are grain, sugar beets and tomatoes. Bowling Green has a large ketchup factory and canneries. It is the seat of a State Normal College. Near by, in the picturesque Maumee Valley, is the Battleground of Fallen Timbers where Gen. Anthony Wayne successfully fought the Indians who were concealed behind trees felled by the wind. Bowling Green was founded in 1832; incorporated as a city in 1904. Pop. 1920, 5,788; 1930, 6,688.

**BOWLING GREEN**, a triangular plot of land at the southern end of Broadway, New York City. It contains a small park and is a convenient situation for elevated railway stations. The spot was laid out as a parade ground and village green and was surrounded by fine residences built by the early Dutch settlers. The sites of these colonial homes are now occupied by sky-scrapers. The Federal Customhouse faces Bowling Green on the south.

**BOWMAN, ISAIAH** (1878- ), American geographer, was born at Waterloo, Ont., Dec. 26, 1878. After graduating from the Michigan State Normal College at Ypsilanti, he studied at Harvard where he became instructor in physiography in 1904. The following year he went to Yale, where he was instructor of geography, and, after receiving his doctor's degree, became assistant professor. In 1915, the American Geographical Society of New York City offered him the post of director. The Yale expedition to Peru in 1907 and the expedition of the American Geographical Society to the central Andes in 1913

were undertaken under his leadership. His writings include numerous articles on South America and contributions to the publications of the United States Geological Survey. Well known are *An American Boundary Dispute* (1923), *The Mohammedan World* (1924) and *The Pioneer Fringe* (1927).

**BOWMAN, JOHN GABBERT** (1877- ), American educator, was born at Davenport, Iowa, May 18, 1877. He graduated in 1899 from Iowa State University, where he became instructor in English in 1902. For four years after 1907 he served as secretary of the Carnegie Foundation for the Advancement of Teaching but returned to Iowa State University in 1911 as president. After three years he became director of the American College of Surgeons and in 1921 was made chancellor of the University of Pittsburgh.

**BOWSTRING-HEMP** (*Sansevieria zeylanica*), a perennial herb of the lily family native to India, valued for the strong fiber obtained from its leaves used for rope making, packing and in various textiles. The stiff, sword-shaped leaves, about 3 ft. long, are arranged in a basal rosette from the center of which springs a tall flower stalk bearing beautiful whitish-green flowers.

**BOX CAR.** See RAILROAD ROLLING STOCK.

**BOX ELDER** (*Acer Negundo*), a tree of the maple family, found from New England to Alberta and south to Florida and Arizona, called also ash-leaved maple. It grows 50 to 70 ft. high, with a short trunk, 2 to 4 ft. in diameter, usually branching into a spreading head. In flowers and fruit it closely resembles the maples, but differs in its leaves, which are more like those of the ash, being divided into several leaflets. Because of its quick growth and handsome foliage it has been widely planted as a shade tree. The soft wood is sparingly utilized; sugar is sometimes made from the sap. The California box elder (*A. Negundo* var. *californicum*), a small tree with leaves usually of three leaflets, grows along streams west of the Sierra Nevada.

**BOXER UPRISING, THE**, an outbreak of attacks on foreigners in North China in 1900. Foreign aggression on China during the preceding decades had created considerable uneasiness and antagonism among the Chinese. The attempt of the young Emperor in 1898 to reorganize China along modern lines by a series of far-reaching edicts issued in rapid succession caused much uneasiness among the more conservative Chinese. Considerable dissatisfaction against the decadent Manchu rule also had been developed. The extremely astute Empress Dowager, Tzu Hsi, succeeded in creating the impression that the foreigners were to blame for all the ills of China, and under her secret instigation a society developed, the members of which called themselves "Boxers." The members of this society were definitely determined to drive the foreigners from China and foreign uneasiness at the growth of the movement led to preparations for military defense, which in turn set off the spark in June, 1900, when the forts below Tientsin were seized by the foreign warships when the Chinese attempted to

prevent the dispatch of foreign troops to Peking. Foreign diplomatic representatives and other foreigners in Peking and Tientsin were besieged by the Boxers. The foreigners in the interior of northeastern China were killed in large numbers, as were many Chinese Christians. An allied expedition landed at Tientsin and forced its way through to Peking, raising the siege there on Aug. 14, 1900. The imperial court fled from Peking on the advance of the allied troops and the Boxer movement collapsed. The Boxer activities were confined almost entirely to the three northeastern provinces of Shantung, Chihli, and Shansi. The viceroys in the Yangtze Valley refused to carry out the Empress Dowager's secret orders to expel the foreigners, and in the other parts of the country the movement scarcely developed at all.

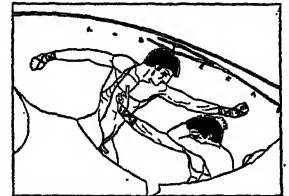
The foreign powers demanded indemnity amounting to \$337,500,000 to be paid out of customs revenue. They also demanded the right to maintain guards at the legations at Peking and at crucial centers along the railway to the sea, as well as to build defenses for the legation quarters. Certain high court officials were required to be executed for their participation in the uprising. The share of the reparations allotted to the United States exceeded the losses sustained by our citizens and the cost of our troops in China. In 1907 China, relieved from paying the balance, showed her appreciation by devoting the money to scholarships for Chinese students in American colleges.

In connection with the Boxer Uprising the Russians moved large numbers of troops into Manchuria, and this movement was one of the causes of the Russo-Japanese War of 1904-5.

**BOXFISH**, one of the various names applied to the common TRUNKFISH (*Lactophrys trigonus*) found in Atlantic waters from Massachusetts to the West Indies.

**BOXING**, the science of self-defense, is frequently called "the manly art." The sport found its inception far back in the days of the Siege of Troy, 2500 B.C. Virgil, the Roman poet, has left a classical description of the ancient sport. We find that amid the clash of arms on the plains of Troy, there was cleared a path for the first fist fight on record. Among the early fistic warriors whose names have come down to us, is Polydeuces, better known as Pollux, brother of Helen of Troy. His name is inseparably associated, in the traditions of both Greece and Rome, with the practice of boxing. With his brother, Castor, he was the patron saint of all public games.

Boxing finds an honored place in mythology. Apollo, besides showing skill in the use of the bow, was famed for his skill with the fists, as were several of the sons of Zeus. Neptune, God of the seas, was the father of Anycus, King of Bebrycians, progenitor of a fighting race. Anycus met his death in a fight with the cestus at the hands of Pollux. From Rome and Greece, the



GREEK BOXERS

headquarters of the art shifted to Sicily, where Eryx ruled with an iron hand. Like Anycus, Eryx had many victories to his credit until he met his conqueror in the great Hercules, whose wanderings had led him to the island. And still further we find references to the first championship belt in fistiana. It is in the *Iliad* where "Diomedes buckled the belt on the costume of the hero after showing the way with the fists." Whereas to-day we use large gloves in order to eliminate the brutality of the cestus and bare-knuckle periods, the feature of the ancient fighting was the "kill" with the cestus, a bare-knuckle contraption made of solid iron or rows of rawhide bound in circular form. It closely resembled the modern brass knuckles used by highwaymen. A battle with the cestus meant a fight to death.

**Revival in Eighteenth Century.** Following the decline of the Roman and Grecian empires, boxing passed from public attention until the start of the 18th century when fisticuffs, cudgeling and quarterstaff matches took the place of the old fights with the cestii. James Figg, the first of the English champions, 1719, was a master in the science of each. He was known in England as the "Father of the Noble Art of Self-Defense."

In 1743, Jack Broughton, second champion, drew up the first set of boxing rules. These called for a ring on the turf and a square yard to be chalked off in the center so that the contestants could toe the scratch from opposite sides when ready for action. A fighter when downed was required to return to the fray within 30 seconds or lose. None but the contestants could enter the ring. He who was unable to continue was to be declared the loser. Two umpires and a referee were to be selected, the umpires to decide unless they were unable to agree on a disputed point, in which case they were to appeal to the third party. A fighter when downed could not be struck by his opponent.

These rules were in force for almost a century, until 1838, and under them, the prize ring flourished in England. Among the great fighters produced while the Broughton rules were in force, were: Jack Broughton, Jack Slack, Tom Johnson, Gentleman John Jackson, John Gully, Hen Pearce, Ben Brain, Isaac Perrins, Bill Hooper, Richard Humphries and Daniel Mendoza, the first Jewish champion, recognized also as the "Father of Scientific Boxing." Others who thrived during that period were: Jem Belcher, Tom Cribb, Aby Belasco, Dan Donnelly, the great Irish fighter, Jack Langan, Tom Spring, Jack Carter, Jack Cooper, Jem Ward and two American Negroes, Tom Molineaux and Bill Richmond.

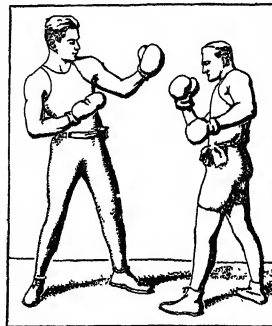
**Revision of Rules.** The Broughton rules were superseded by a set drafted in 1838, which, while they were an improvement over those that had lasted a century, still sanctioned brutality. They were the London Prize Ring rules which provided for bare-knuckle fights in which wrestling was permitted, and these, 20 years later, in 1858, gave way to the revised London Prize Ring rules as adopted by the National

Pugilistic Association, which differed only slightly from the old code. They called for turf fighting, two umpires and a referee, two bottle holders, handkerchiefs with the respective colors of the fighters on them and a long list of rules which defined various forms of fouls. It was under these rules that the latest fights in the history of pugilism, both with the bare knuckles and in skin tight gloves, took place. The leaders of pugilism under these rules were:

Tom Hyer, first American champion; Yankee Sullivan; John Morrissey, Congressman-fighter; John C. Heenan, the Benecia boy who fought a thrilling 42-round draw with Tom Sayers at Farnborough, England, in 1860, the first great international fight between America and England; Deaf Burke; Tom Cannon; Joe Coburn; Ned Price, actor, lawyer, dramatist, author, pugilist; James Dunn; James Elliott; Mike McCool; William Davis; Ben Hogan, first German fighter; Joe Wormwald; Ned O'Baldwin, the Irish Giant; Joe Goss; Jem Mace, England's most scientific boxer; Johnny Dwyer; Paddy Ryan; Jake Kilrain, and the immortal John L. Sullivan.

Sullivan was the greatest of all bare-knuckle fighters. He held the title 10 years. He won it from Paddy Ryan on Feb. 7, 1882 at Mississippi City, Miss., in nine rounds, defended it successfully in the last bare-knuckle championship fight at Richburg, Miss., July 8, 1889 against Jake Kilrain, winning in 75 rounds, and then was whipped by James J. Corbett on Sept. 7, 1892 at New Orleans, in the first heavyweight championship fight under the Marquis of Queensberry rules, in which big gloves were used for the first time.

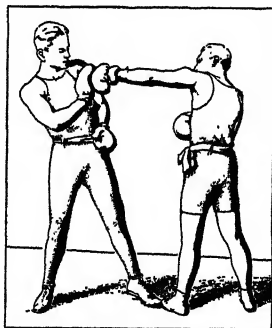
**International Code Adopted.** It was in 1865 that the Marquis of Queensberry and Arthur Chambers, lightweight king, decided to revise the London Prize Ring rules because of the brutality which they permitted, and the Queensberry code was adopted for all amateur fights in England and America. It was



COURTESY AM. SPORTS PUB. CO.  
SPARRING FOR AN OPENING



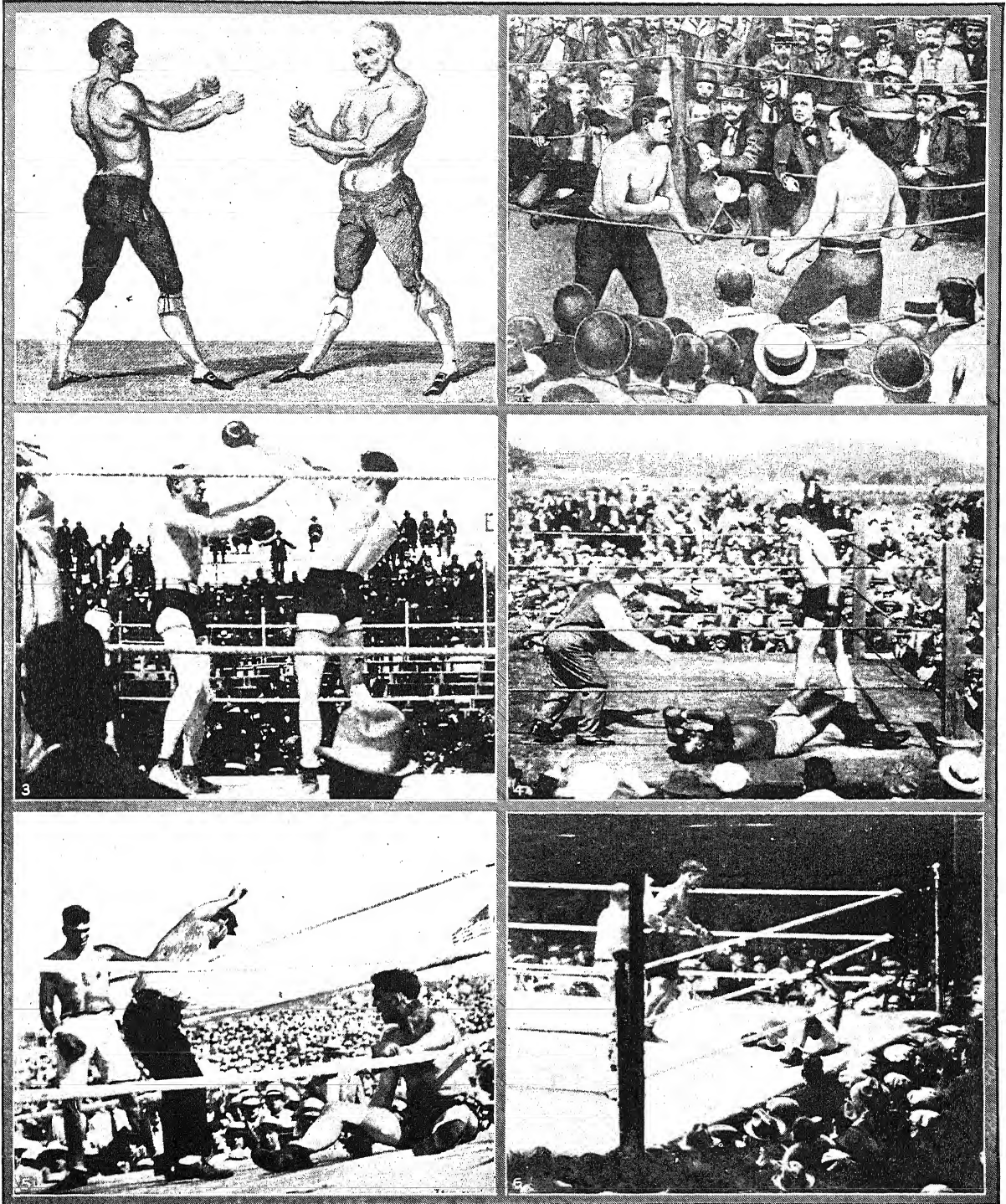
COURTESY AM. SPORTS PUB. CO.  
PULLING DOWN OPPONENT'S  
HAND TO MAKE AN OPEN-  
ING



COURTESY AM. SPORTS PUB. CO.  
BLOCKING A LEFT SWING



## BOXING



COURTESY OF THE RING, INC.

### FAMOUS CHAMPIONSHIP FIGHTS

1. A famous bare-knuckle fight, Apr. 10, 1750. Jack Broughton, English champion, *vs.* Jack Slade. 2. Seventy-five rounds and no gloves. Sullivan defeats Kilrain in last bare-knuckle bout, July 8, 1889. 3. Fitzsimmons *vs.* Corbett, March 17, 1897. Corbett lost the heavyweight championship on a solar plexus punch in the 14th round.

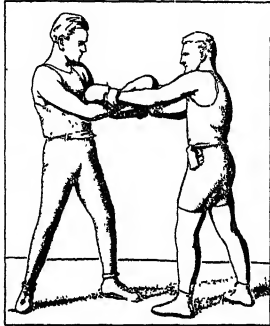
4. Referee counting out Jack Johnson, Negro champion, in fight with Jess Willard, Havana, July 4, 1915. 5. Fourth knockdown in Dempsey-Willard bout, July 4, 1919. Dempsey won in three rounds. 6. The famous long count in the Tunney-Dempsey fight, Chicago, Sept. 22, 1927.





not until the advent of Corbett as title holder, however, that the rules, slightly modified, became the international code for professional boxing. Since then they have been altered to meet the modern requirements of state boxing commissions. But despite the changes and the introduction of local amendments, the rules now in vogue the world over have as their basic principles, the features of the London Prize Ring and Queensberry codes.

The Marquis of Queensberry code's features may be summed up as follows:



COURTESY AM. SPORTS PUB. CO.

PINNING OPPONENT'S HANDS  
IN DRAWING AWAY FROM  
CLINCH

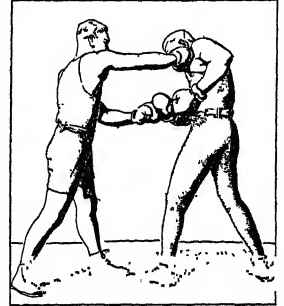
The ring is 24 feet square within the ropes, has padded floors, four posts, one in each corner, and ropes fastened to these posts. Wrestling or hugging is barred. The rounds are of three minutes' duration with one minute rest between rounds. No fighter may be assisted except during the rest period. No person is allowed to enter the ring other than the referee. The gloves weigh six ounces each, but vary

in some states and countries. The bout is determined on a points system, these being awarded for aggressiveness, cleverness, defense, attack, clean hitting, forceful hitting, guarding and ducking. A fighter who fouls subjects himself to disqualification. The referee can stop a contest if in his opinion a fighter is unfit to continue.

**Heavyweight Champions.** The heavyweight champions since the adoption of the Queensberry rules follow: James J. Corbett knocked out John L. Sullivan in the 21st round at New Orleans, Sept. 7, 1892. Corbett was knocked out by Robert Fitzsimmons, 14 rounds, Mar. 17, 1897, Carson City, Nev. Fitzsimmons was knocked out by James J. Jeffries, June 9, 1899, Coney Island, N.Y., 11 rounds. Jeffries retired and Tommy Burns claimed the title after he had won 20 round decisions from Marvin Hart, Feb. 23, 1906 and from Philadelphia Jack O'Brien, May 7, 1907. Burns was stopped by Jack Johnson, Dec. 25, 1908, Sydney, Australia, 14 rounds. Jeffries reclaimed the title in 1910 but was stopped by Jack Johnson at Reno, Nev., July 4, 15 rounds. Johnson was knocked out by Jess Willard, July 4, 1915, Havana, Cuba, 26 rounds. Willard was knocked out by Jack Dempsey, July 4, 1919 at Toledo, O., 3 rounds. Dempsey lost on points to Gene Tun-

ney, Sept. 23, 1926, Philadelphia, 10 rounds, decision. Gene Tunney retired and after a series of elimination bouts, Max Schmeling gained international recognition by winning on a foul, 4 rounds, from Jack Sharkey, June 12, 1930, in New York. Sharkey won the bout with Schmeling on June 21, 1932, by decision.

The rules of boxing call for a referee and a time-keeper and in some states and countries for two judges. A fighter may lose a bout through a foul, a knockout, a points decision, physical disability or the action of a second in throwing the sponge or towel into the ring. The more prominent fouls internationally recognized are the pivot punch, rabbit punch, kidney blow, biting, gouging, heeling, hitting with the back of the gloves, hitting below the belt or wrestling.



COURTESY AM. SPORTS PUB. CO.

BLOCKING A LOW RIGHT UPPERCUT WITH LEFT AND SWINGING RIGHT TO JAW

Boxing championships are classified in eight divisions: flyweight, 112 lbs.; bantam weight, 118; featherweight, 126; lightweight, 135; welterweight, 147; middleweight, 160; light heavyweight, 175, and heavyweight, which includes weights over 175. N. S. F.

**BOXING THE COMPASS.** See COMPASS.

**BOX TURTLE.** See TURTLE.

**BOXWOOD**, the valuable wood produced by the common box (*Buxus sempervirens*), an evergreen shrub or small tree of the box family, native to Europe, western Asia and northern Africa. The box tree is of very slow growth, usually attaining a height of about 12 ft. It bears small, leathery, glossy green leaves and inconspicuous flowers. Several dwarf and arborescent forms are widely grown in gardens and as hedging, often clipped into formal shapes. Boxwood is light yellow, close grained and hard, taking a fine polish. It is of unique value to the wood-engraver, and is much used by turners and makers of mathematical and musical instruments.

**BOYARS** (Russian *boyarin*, master, lord, from Turkish *bayar*, magnate). In early Russian history, the chief vassals and members of the retinue of a medieval Russian prince, hence the highest class in Russian medieval society, in the later Middle Ages, semi-independent feudal barons. Under the early princes, the boyars formed a council which advised the prince in important matters of policy. While originally of military profession, the boyars of the twelfth century had begun to acquire estates and thus laid the foundation for an agricultural aristocracy with extensive freeholds. With the growth of these estates after the Tatar incursions, the princely power weakened, and the country took on the familiar aspect of feudal dismemberment which continued until the rise of Moscow from the 14th century forward. The Muscovite princes deprived the landed boyars of their previous independence and laid upon them various



COURTESY AM. SPORTS PUB. CO.

SLIPPING RIGHT HOOK TO HEAD AND COUNTERING WITH RIGHT TO BODY

obligations and servitudes. The boyars lacked the requisite solidarity to resist the evolution of princely absolutism which culminated in the tyranny of Ivan the Terrible, under whom they were impoverished and oppressed, finally disappearing as a dominant class.

**BOYCOTT**, a combination, usually voluntary, to withhold business or social relations with a person, organization or community. The word is derived from the name of an Irish landlord, Captain Boycott, who, in 1880, refused to receive rents at figures set by his tenants, and whose property and even life were threatened by them. It is a weapon of organized labor to bring to terms refractory employers by checking their sales and profits. Primary boycotts involve the refusal of a single group of workers to deal with an unfair employer. In secondary boycotts the workers attempt to persuade or coerce other workers or the public into refusing to patronize the unfair firm. Their extensive use has resulted in hardship and financial loss to disinterested parties and many states have legislated against them by laws providing that any boycott is illegal in which there exist malicious attempts to injure, violence or threat of violence, or attempts to coerce third parties.

The Chinese have effectively employed boycott, on an almost national scale, against the goods and persons of nations against whom they were aggrieved.

D. P. B.

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**BOYD, ERNEST** (1887- ), American critic, was born at Dublin, Ireland, June 28, 1887. He was educated privately and entered the British consular service in 1913. He served as Vice Consul at Baltimore, Barcelona and Copenhagen before settling in New York in 1920. Since that date he has devoted his time to writing. Among Boyd's works are *Contemporary Drama of Ireland*, *Appreciations and Depreciations*, *Literary Blasphemies* and *The Virtue of Vices*.

**BOYSEN, HJALMAR HJORTH** (1848-95), Norwegian-American novelist and educator, was born at Frederiksværn, Norway, Sept. 23, 1848. He was educated at the Oslo (Christiania) University, came to the United States in 1869 and was editor of a Norwegian journal in Chicago. A few years later he went to Germany and studied Germanic philology at Leipzig. After two years he returned to the United States and became a professor of German at Cornell University, where he remained until he was called to the chair of Germanic languages at Columbia College, now Columbia University. Boyesen wrote several novels, *Gunnar*, *A Norseman's Pilgrimage*, *Falconberg*, *Ilka on the Hill-Top*, *Queen Titania*, *A Daughter of the Philistines* and some books connected with the subjects that he taught, *Goethe and Schiller: Their Lives and Works*, *A Commentary on the Works of Henrik Ibsen* and *Essays on Scandinavian Literature*. He died at New York City, Oct. 4, 1895.

**BOYLE, ROBERT** (1627-91), English chemist and physicist, was born at Lismore, Ireland, Jan. 25,

1627. After some years of philosophic and religious study, he turned to natural science and physical experiments. He discovered the law now known as **BOYLE'S LAW**: that the volume of a gas at constant temperature varies inversely with the pressure. He disagreed with the chemical theory of the Aristotelian four elements and propounded a type of atomism which powerfully affected the development of modern chemistry. He died in London, Dec. 30, 1691.

**BOYLE'S LAW**, enunciated by **ROBERT BOYLE** in 1662, states that, at constant temperature, the volume of a given mass of gas is inversely proportional to the applied pressure. Stated mathematically, it is  $p\nu = c$ , where  $p$  and  $\nu$  denote, respectively, pressure and volume, and  $c$  is a constant. The numerical value of  $c$  depends upon the mass and temperature of the gas, the kind of gas and the units in which  $p$  and  $\nu$  are expressed.

No actual gas conforms perfectly to Boyle's Law, but the departures from it are so slight that they are usually neglected in all but the most exact work. For all of the common gases, except hydrogen, the value of  $p\nu$  decreases slightly as the pressure is raised, indicating that they become slightly more compressible; for hydrogen,  $p\nu$  increases slightly. When Boyle's Law is combined with **CHARLES' LAW**, the equation is  $p\nu = mRT$ , where  $m$  and  $T$  are, respectively, the mass and absolute temperature of the gas and  $R$  is a constant. Boyle's Law is sometimes called Mariotte's Law.

**BOYNE, BATTLE OF THE**, July 1, 1690, a battle fought on the banks of the Boyne River, near Drogheda, Ireland, by King William III with an army of 36,000 British, Dutch and Huguenot soldiers and King James II, whose army of 26,000 was mostly Irish. By his broken promises and persecutions James had won the hatred of the English, who invited William of Orange to displace him. The battle ended in a decisive and momentous victory for the Protestant forces. James, the last Catholic king of England, fled to the Continent where he lived in exile the rest of his life.

**BOY SCOUTS OF AMERICA**, a movement for character building and citizenship training for boys through a program of directed activity, in cooperation with the home, church and school. It was incorporated in Feb. 1910, and granted a Federal charter by Congress in 1916. It is non-sectarian and neither military nor anti-military. The President of the United States is Honorary President, and former Presidents are Honorary Vice-Presidents.

Scout Troops are organized in connection with institutions, such as schools or churches. A Troop consists of not more than 32 boys, organized into four Patrols, under the leadership of a Scoutmaster, who is an adult male citizen, and one or more assistants. Farm or Home Patrols of from two to eight boys may be organized in communities too small to start a troop. The Lone Scout program provides for boys in isolated communities. The Boy Scout organization

also sponsors a program for boys from 9 to 11 years of age inclusive, who are known as Cubs. Sea Scouting is a branch dealing with water activities for boys of 15 years and over. Scouting is administered locally by Local Councils, composed of representatives of the troops. The governing body of the Boy Scouts of America is the National Council, composed of representatives of Local Councils and other outstanding citizens. It operates through a National Executive Board.

The Boy Scout movement is established in over 73 countries. World gatherings of Scouts are held every four years; 50,000 boys attended in 1929.

The number of members since 1910 has totaled 5,670,786; on Dec. 31, 1931, 908,685 Scouts, Scouters, Cubs and Cubbers, organized in 29,527 units, were enrolled.

**BOYS' WORK AGENCIES**, organizations and welfare agencies which deal with boys in their leisure time.

Where living conditions are most abnormal and active play opportunities are most rare, JUVENILE DELINQUENCY and other manifestations of social maladjustment show themselves most commonly. Among the major organizations which have directed themselves to the problem of boy leadership are the Boy Scouts of America, with a well articulated program of activities, serving about 750,000 boys; the Y.M.C.A., caring for several hundred thousands of boys with a social, recreational and religious program functioning largely with the Protestant evangelical group; and the Boys' Clubs, specific social service institutions of which about 250 are functioning in 130 American cities. These latter serve boys of a community or neighborhood with a recreational, health and vocational guidance program, having dues-paying members, giving no religious instruction and having no racial or other restrictions upon their membership. About 160 settlements or community houses maintain boys' departments.

In almost every state, rural boys and girls have been enlisted in what are known as 4-H Clubs, assisted by Federal, state and county subsidies through the farm bureau movement. Programs are based largely upon rural interests, but many recreational activities are included. The playgrounds in many cities, generally supported by public funds, provide leadership and meeting places for boy groups. In some instances these groups are called Boys' Clubs.

Churches which provide recreational leadership for week day activities handle a considerable number of boys with recreational programs organized on a parish basis. The men's organizations of the Catholic and Jewish faiths do work with boys, the former through the Boy Life Bureau maintained by the Knights of Columbus, and the latter through the National Jewish Welfare Board functioning locally as Young Men's Hebrew Associations or Jewish Community Centers.

R. K. A.

**BOZEMAN**, a city in southeastern Montana, the county seat of Gallatin Co., situated in the Gallatin

Valley, surrounded by mountains, 103 mi. southeast of Butte. Two railroads afford transportation. Bozeman is in a rich grain-growing region. It is the northern gateway to Yellowstone National Park. Flour and cereal mills and pea canneries form the local industrial activities. Bozeman was founded in 1864; incorporated 1883. Pop. 1920, 6,183; 1930, 6,855.

**BRABANÇON REVOLT**. See BELGIUM, HISTORY OF.

**BRABANT**, a district in the central part of Belgium; area 1,268 sq. mi. In the 15th century it passed to the house of Hapsburg and to the control of Charles V. At the abdication of the latter in 1555, it became part of the possessions of Philip II of Spain, later being divided into separate districts, each of which underwent several changes in government. The capital of the section now known as Brabant is BRUSSELS. Est. pop. 1930, 1,677,584.

**BRACCIOLINI, GIAN FRANCESCO POGGIO**. See POGGIO.

**BRACHISTOCHROME**, a term, derived from the Greek *brachistos*, shortest, + *chronos*, time, for the curve down which a body will descend from one point to another in the quickest time. It was studied by GALILEO, LEIBNIZ, NEWTON and the BERNOULLIS. The curve is a cycloid. See CURVES; CYCLOID.

**BRACKENRIDGE**, a borough of Allegheny Co., southwestern Pennsylvania, 22 mi. northeast of Pittsburgh, on the Allegheny River. It is served by the Pennsylvania Railroad. Gas and coal are produced near by, and the borough manufactures steel and glass. There are truck gardens in the vicinity. Brackenridge was incorporated in 1901. Pop. 1920, 4,987; 1930, 6,250.

**BRACKET FUNGI**, a numerous group of tube-bearing fungi (*Polyporaceæ*), called also shelf-fungi. They form hard, woody, shelf-like or bracket-like growths on the trunks of trees. Some grow also upon fallen logs and other dead timber, contributing to the process of decay known as dry rot.

**BRACON, HENRY DE** (d. 1268), English ecclesiastic and jurist, was born in Devonshire. He was chiefly famous for his work *De Legibus et Consuetudinibus Angliae*, the first comprehensive treatise on English law. He obtained his law doctorate at Oxford, and in 1244 was appointed a circuit judge. Ten years later he became chief justice of England, in which office he remained for twenty years. In 1264 he accepted the chancellorship of Exeter Cathedral, where he was buried in 1268. The *Legibus* is the finest volume on law by an English jurist of the Middle Ages. In 1923 a group of lawyers presented Exeter Cathedral with a memorial tablet for Bracton's tomb.

**BRADDOCK, EDWARD** (1695-1755), British general was born in Perthshire, Scotland about 1695. The general came to America in 1755 to command the British forces against the French and in July of that year he organized a band of British and provincial soldiers to take Fort Duquesne, now Pittsburgh.

On their march when passing through a dense forest they encountered an ambushade of Indians and at the same time were attacked by the French; scarcely half of the men escaped, these being led to safety by Col. Washington, Braddock's aide-de-camp. Braddock was wounded and died at Great Meadows, July 13, 1755.

**BRADDOCK**, a steel-manufacturing borough in Allegheny Co., southwestern Pennsylvania. It is situated on the Monongahela River, 10 mi. southeast of Pittsburgh and is served by river craft and three railroads. Braddock with North Braddock and Rankin forms one large steel-mill community. The industrial output of Braddock itself was worth \$11,008,108 in 1927. In 1929 the factory output was valued approximately at \$8,000,000; the retail trade amounted to \$10,664,323. John Frazier settled here in 1742. During the French and Indian War General Braddock was mortally wounded here July 9, 1755. The village was the scene of a peaceful assembly of 8,000 men to protest against the government tax on whiskey, Aug. 1, 1794. Braddock became an incorporated borough in 1867. The first Carnegie Library in this country was established here. Pop. 1920, 20,879; 1930, 19,329.

**BRADDOCK'S DEFEAT**, an event of the FRENCH AND INDIAN WAR. Gen. Edward Braddock arrived in Virginia with two British regiments, Feb. 1755, and augmented by a body of militia under GEORGE WASHINGTON marched against the French stronghold, Fort Duquesne, at the Forks of the Ohio. Leaving Wills Creek, Md., in May, the expedition literally cut its way through the forest, leaving a road which later became a chief artery of pioneer travel. When within 30 miles of Fort Duquesne he sent forward an advance force of 1,200 men under Col. Gage. On July 9 this force, five miles from the fort, was ambushed by 200 French and 600 Indians. At the sound of firing Braddock pushed forward rapidly; but his troops, unaccustomed as was Braddock himself to conditions of wilderness warfare, were decisively defeated. After Braddock was mortally wounded Washington conducted the retreat. The British loss was over 1,000 men.

**BRADENTON**, a city and inland port on the western coast of Florida, on the Manatee and Braden rivers, 8 mi. from the Gulf of Mexico and 45 mi. south of Tampa. Bus lines, ocean-going steamers, small boats and two railroads serve the city. The surrounding region produces abundantly vegetables and citrus fruits. Bradenton is an attractive winter resort, with excellent fishing and boating. About 1854 Joseph Braden settled here and built Braden Castle, which is still standing. Judah Phillip Benjamin, Confederate Secretary of State, hid himself in Gamble Mansion, not far from the city, after Lee's surrender. The Mansion is preserved as a memorial to him. Bradenton was incorporated in 1903. Pop. 1920, 3,868; 1930, 5,986.

**BRADFORD, GAMALIEL** (1863-1932), American author, was born at Boston, Mass., Oct. 9, 1863. He studied at Harvard for a short time, leaving be-

cause of ill health, and devoted his life to writing. Bradford is the author of numerous essays and biographical sketches of prominent Americans, including *Confederate Portraits*, 1914, *Union Portraits*, D. L. Moody, *Wives*, *American Portraits*, 1922; *Pageant of Life*, *Daughters of Eve*, 1930, and *The Quick and the Dead*, 1931. He died at Wellesley Hills, Mass., Apr. 11, 1932.

**BRADFORD, ROARK** (1896- ), American writer of Negro stories, was born in Laureldale Co., Tenn., Aug. 21, 1896. He attended the University of California. *Child of God*, his first short story, won the O'Brien Prize Award in 1927. *The Green Pastures*, Pulitzer Prize play in 1930, was based on Bradford's *Ol' Man Adam an' His Chillun*. Among his other works are *This Side of Jordan*, 1929, and *Ol' King David and the Philistine Boys*, 1930.

**BRADFORD, WILLIAM** (1589?-1657), English governor of Plymouth Colony, was born at Austerfield, Yorkshire, between 1589 and 1590. He sailed from Leyden, on the Mayflower in 1620, and became the second Governor of Plymouth Colony, succeeding Governor Carver, in 1621. One of his first acts as governor was to confirm the treaty with Massasoit just in time to suppress a dangerous Indian conspiracy. He was elected governor thirty times, serving with brief interruptions from 1621 to 1656. Bradford exercised a more plenary authority than any other English colonial governor between 1619-85. His tact, sound judgment and marked ability as an administrator were greatly responsible for the success of the struggling colony. His *History of Plimmoth Plantation* from 1602-47, is a valuable historical record.

**BRADFORD**, a city in the West Riding of Yorkshire, England, on a tributary of the Aire, 9 mi. west of Leeds. Bradford is the chief seat in England of the spinning and weaving of worsted yarns and woollens. Most of the principal streets of the city radiate from the town hall, a handsome building opened in 1873. The parish Church of St. Peter, 1485, is built in the Perpendicular style and occupies the site of an early Norman church. Its special feature is the original oak roof. Colleges, art galleries, museums and three parks, each with over 50 acres of beautiful trees and flowers, are in the city. A large acreage of moorland in the vicinity is maintained as a public recreation ground. Records exist that Bradford was almost destroyed during the Norman Conquest when the north of England was laid waste in 1086. Pop. 1921, 291,004; 1931, 298,041.

**BRADFORD**, a city of McKean Co., northern Pennsylvania, in the beautiful foothills of the Alleghenies, 1,400 ft. above sea level, about 78 mi. southeast of Buffalo, N.Y.; it is served by the Pennsylvania, Erie and Buffalo, Rochester and Pittsburgh railways, by bus lines and an airport. Bradford is located in very productive oil country. The principal manufactures are petroleum products, brick, cutlery and oil well supplies. In 1929 their aggregate value was about \$17,000,000; the retail trade amounted to \$14,896,120. Allegheny State Park is 3 mi. away.



Bradford, settled about 1825 by the Connecticut-Susquehanna Company and William Bingham, was first called Littleton. It adopted its present name in 1858. Bradford was incorporated as a borough in 1873 and became a city six years later. Pop. 1920, 15,525; 1930, 19,306; about 10% were foreign-born.

**BRADFORD-ON-AVON**, an urban district of Wiltshire, England, 98 mi. southwest of London. Of native greystone, it lies picturesquely scattered up the steep banks of the Avon. Among its antiquities is an ancient bridge boasting a midspan chapel that at one time served as a lock-up, and there is the perfect, small Church of St. Lawrence with a nave higher than it is long. Kingston House is considered one of the finest Jacobean mansions in England, and at Barton Farm is a well-preserved 14th century tithe-barn. Gainsborough loved and painted ancient Bradford. Once a clothing industry center famous for its broadcloth, to-day the town's interests lie chiefly in a considerable tourist traffic. Pop. 1921, 4,624; 1931, 4,735.

**BRADLEY POLYTECHNIC INSTITUTE**, Peoria, Ill., a coeducational, privately controlled, non-sectarian institution, founded in 1897 by Mrs. Lydia Bradley. At first it offered four years of academy and two years of college work, but has since developed into a Liberal Arts College with technical courses, and schools of Music and Horology, the academy being discontinued in 1922. The institute had productive funds in 1931 amounting to \$2,795,041. The library contains 32,058 volumes. In 1930 there were 1,961 students and a faculty of 67, headed by Pres. Frederic R. Hamilton.

**BRADSTREET, ANNE** (1612-72), Colonial poet, was born at Northampton, England, in 1612. She emigrated with her husband to Massachusetts Bay in 1630; and both her husband, Simon Bradstreet, and her father, Thomas Dudley, became governors of the settlement. Her verse gained her great fame in her day, and she was called "The Tenth Muse." Anne Bradstreet was the first woman in America to devote herself to poetry. She died at Andover, Mass., Sept. 16, 1672.

**BRAGA**, capital of the Portuguese district of the same name, picturesquely situated on an eminence in a fruitful valley. The old walled city contains a fine cathedral rebuilt in the 16th century on the site of the 12th-century basilica, handsome squares and streets, an archiepiscopal palace, a theological seminary and other schools. There is active trade and local industry. The *Bracara Augusta* of the Romans, it was capital of the Suevi in the 5th century and of the kings of Portugal in the 12th. Pop. 1931, 26,962.

**BRAGANZA, HOUSE OF**. The last royal house of Portugal were originally Dukes of Braganza, lords of the city and district of that name in the fertile province of Traz-os-Montes. The first duke was created in 1442, when Affonso, bastard son of King John I and Ines Pires, was given the title by his half-brother Pedro, then regent for the young king Affonso V. Forty years later, owing to the liberality

of the Portuguese kings, Ferdinand, the grandson of the first duke, was the possessor of 50 cities and castles, nearly one-third the land of Portugal, and the patron of 160 religious benefices. Easily the richest man in the kingdom, Ferdinand maintained a royal household and led the nobility in its opposition to a centralizing monarchy. Perceiving the danger of his position, King John II took the first opportunity in 1483 to charge, arrest and finally execute Ferdinand after the most perfunctory of trials. In the next century, the marriage of the sixth duke, John of Braganza, to Catherine of Guimaraens, the King's niece, gave the family one of the best claims to the throne in the multiple rivalry that followed the death of the Cardinal King Henry. By bribery and force, however, PHILIP II of Spain succeeded in uniting temporarily the two countries. It was a descendant of Catherine who in 1640 regained the throne of Portugal as John IV, largely, be it said, through the manly efforts of his wife, a Spanish noblewoman of the Medina Sidonia family. After founding the imperial line of Brazilian rulers, the Braganza family died out in the male line, though perpetuated on the throne of Portugal as the house of Saxe-Coburg-Gotha until the expulsion of Manoel II in 1910, when the republic was established. *See also* PORTUGAL.

J. BA.

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**BRAGE or BRAGI**, in Scandinavian mythology, the god of wisdom, poetry and eloquence. He was the son of ODIN and Frigga. He welcomed the heroes who died in battle into Valhalla. He is represented as an old man with long beard and a kind eye.

**BRAGG, BRAXTON** (1817-76), Confederate soldier, was born in Warren Co., N.C., Mar. 22, 1817. He graduated from West Point in 1837, and served in the Seminole and Mexican Wars. In 1861, he became a brigadier general in the Confederate Army, and the following spring was promoted to general, succeeding Beauregard in the command of the Army of the Mississippi. He fought against Buell at Perryville and withdrew; met a reverse from Rosecrans at Murfreesboro; won a notable victory from Rosecrans at Chickamauga; and was in turn defeated by Grant at Chattanooga, after which he was relieved of his command and was appointed chief of staff to Jefferson Davis. After the war, Bragg practised as a civil engineer. He died at Galveston, Tex., Sept. 27, 1876.

**BRAGG, SIR WILLIAM HENRY** (1862- ), British physicist, was born at Wigton, Cumberland, July 2, 1862. He taught physics and mathematics at Adelaide, South Australia, during 1886-1908, where he undertook experiments on radioactive materials. He was elected a fellow of the Royal Society in 1906, and in 1909 joined the faculty of Leeds University. In 1915 he became professor of physics at the University of London and was awarded the Nobel Prize for physics, and was knighted in 1920. He was elected president of the British Association for the Advancement of Science in 1928. In collaboration

with his son, William Lawrence Bragg (1890- ), the elder Bragg continued his investigation of radiation, applying X-ray analysis to crystals and developing molecular analysis by means of the spectrometer. His work contributed importantly to the solution of problems relating to the arrangement of atoms in crystals and the molecules of compounds. His published works include *The World of Sound*, *Concerning the Nature of Things* and *Creative Knowledge*, the last work appearing in 1927.

**BRAGI.** See BRAGE.

**BRAHE, TYCHO** (1546-1601), Danish astronomer, was born at Knudstrup near Lund, in what was then Denmark, Dec. 11, 1546. He was sent to Copenhagen to study at the age of 13, and to Leipzig in 1562. Ostensibly he studied law, but gave more attention to astronomy and mathematics, and soon devoted himself entirely to these subjects. For a while he lived in Germany, but after his return to Denmark in 1573 managed to interest the Danish king, Frederick II, in his work. The latter built an observatory called Uraniborg for him on the island Hven, and it was here that Tycho Brahe assiduously devoted himself to making observations of the stars and planets. After the king's death in 1588 his position became precarious and in 1597 he was forced to leave the country. For some time he wandered around Germany and finally settled near Prague as court astronomer to the emperor Rudolph II, where he succeeded in having Kepler join him in 1600.

Tycho Brahe did not fully believe in the Copernican theory and in order to prove his own ideas began a long series of observations which he pursued with a zeal and executed with an accuracy never attained before. It is on his skill as an observer that his fame rests, for it was his precise observations of the planets that furnished Kepler with the material from which to derive his fundamental laws of planetary motion. He died at Prague, Oct. 24, 1601.

**BRAHMA**, the chief god of the Hindu religion. He pervades other gods, but those especially connected with him are Vishnu, the Preserver, and Siva, the destroyer and redeemer. Brahma is the creator. These three form the triad called Trimurti. The goddess of eloquence, Sarasvati, was Brahma's wife. He was supposed to have had five heads, one of which was destroyed by Siva.

**BRAHMAN CATTLE.** See ZEBU.

**BRAHMANISM**, the antecedent form of HINDUISM, or Indian religion as described in the "aryan" literature of the pre-Christian era, especially the Brahmanas. As such, Brahmanism is to be distinguished from the Brahmanized Hinduism of later times. The word *brahman* meant at first the "holy power" within the universe (akin, perhaps, to the primitive *mana*); *brih*, "swell," and *brihas*, "prayer" are of the same root with *brahman*. Afterwards, *brahman* came to mean the cosmic principle which produces, organizes, and informs the universe; Brah-

man absorbs the functions and the forms of many gods of the earlier time (the gods, for example, of the Vedas) and becomes the All. The term *atman* runs through some such development as wind, breath, and self, and at last the fundamental equation of Brahmanism is established, namely, that *brahman* equals *atman*; they are one. Brahman is the greatest religious term in Indian history. It represents the fusion of all the elements of early polytheism into one grand pan-theistic whole; this is the ground of the later Vedanta, "end of wisdom," according to Shankara.

Since the Brahman priest early achieved social and religious preeminence in India, Brahmanism may be considered Indian "priestly" religion. As such it flourished around 800 B.C., at which time there were temples and hierarchies, and the Brahmins were custodians of literature and learning. There were many nature gods and other powers, but they were in process of becoming aspects of the Brahmanic One. Caste was then forming out of antecedent diversities of work and life, and the Brahmins (themselves God, in theory) fostered the notion that caste was the will of God. Sacrifice, the chief element and factor in ritual, was in charge of the priests, and the goal of religion was the dutiful performance of ceremonial works. The doctrine of *karma* and transmigration was at most only a vague conception then, and salvation was something other than release from the karmic round; non-priestly philosophy came later and Indian philosophical systems arose still later. By works the gods were served, man's confidence established, and prosperity assured. At death, dutiful men joined the gods. However, in the Brahmanical system there were already all the necessary germs for the subsequent development of Hinduism.

J. C. A.

See M. Bloomfield, *The Religion of the Veda*, 1908; A. B. Keith, *Religion and Philosophy of the Veda*, 1925.

**BRAHMAPUTRA**, a river of India which flows through Assam and Bengal into the Bay of Bengal, after a course of 1,800 mi. It rises in Tibet as the Tsamp and cuts through the Himalayan system in a deep transverse gorge 170 mi. in length, dropping in level from 8,000 ft. to 400 ft., or 47 ft. per mi. This stage of the river, in which it is known as the Dihang, is difficult of access, and is in part unsurveyed. Thence to the junction with the GANGES the fall is little more than six in. per mi., and this sudden change of incline is accompanied by the deposition of silt in enormous quantities around the slightest ob-



COURTESY M. M. OF ART

**BRAHMA**  
South Indian statue of stone,  
10th century

stade, such as a fallen tree or an anchored steamer. The swamps which closely adjoin the elevated alluvial foundation of the river bed are flooded in the rainy season, until the lower reaches of the valley are a vast sea from which the hills slope up on either side. A regular service of steamers plies from Goalanda to Dibrugarh, a course of 800 mi.; large vessels can ascend to Gauhati.

**BRAHMS, JOHANNES** (1833-97), German music composer, was born at Hamburg, May 7, 1833. His father, Johann Jacob Brahms, was a double-bass player, and his mother was Johanna Henrika Nissen. Johannes was the second of three children. As a boy he studied with Cossel and Marxsen, making his first appearance as a pianist at the age of 15. Five years later he toured with Remenyi in recital and in 1854 became court music director to the Prince of Lippe-Detmold, holding this post four years. In 1862, at the age of 29, he settled in Vienna, where, for one year, he conducted at the Singakademie, and from 1872 to 1875 he conducted the Gesellschaft der Musikfreunde. He held no other official posts, and lived a quiet and uneventful life, dedicating his existence to composition, save for occasional appearances in concert. Like BEETHOVEN he was largely self-instructed, and like him also he remained a bachelor.

The comparison with Beethoven is relevant, since there is strong similarity between the music of the Bonn master and that of Brahms. Their compositions, while highly individualistic, seem to stem from the same spiritual passion; there is an unmistakable affinity, amounting at times to identity, between their utterances: the finale of Brahms' first symphony, for example, so strikingly resembles (without suggesting plagiarism) the finale of Beethoven's ninth and last symphony that Hans von Bülow pointedly named the former the "tenth" symphony. In any event, say what one may of all comparisons, Brahms is the direct successor of Beethoven and the only composer yet born whose music is worthy of that taxing juxtaposition. In his four symphonies, violin concerto, two pianoforte concertos, his many songs, chamber music, numerous pianoforte works, and in his chief choral creation, the *German Requiem*, the listener is brought into the presence of true genius which musically, no less than alphabetically, takes its place among the "Three B's" of tonal eloquence. Brahms died at Vienna, Apr. 3, 1897.

**BIBLIOGRAPHY.**—E. M. Lee, *Brahms, the Man and His Music*, 1916; J. Pulver, *Johannes Brahms*, 1926.

**BRAIDS.** In ordinary braids, each end or strand of the material crosses in a diagonal direction alternately over and under one or more ends. They may be divided roughly into two distinct classes: round braids and flat braids.

In round braids one series of ends is rotated continuously in one direction along a serpentine raceway or carrier course and interlaces with another series of ends that is rotated along a serpentine raceway in the opposite direction. The resultant fabric is tubular and may have a solid core or remain hollow.

In flat braids each strand crosses in a diagonal direction alternately from left to right and vice versa, and in so doing interlaces with the strands crossing in the opposite direction. The resultant fabric is flat and of only one thickness. Flat braids are often designated by the number of lines, one line comprising the space of four ends.

Longitudinal threads or warp ends may be introduced into a round or a flat braid during the braiding operation to serve a particular utilitarian or ornamental purpose. In elastic braids india rubber strands are substituted for the warp ends.

The machine on which braid is made is known as a braider. It is circular in shape, may vary from one to five ft. in diameter, and from 12 to 30 in. high. The size of the machine is determined by the number of carriers or bobbins it is designed to carry.

Common articles produced on braiding machines include shoe laces, corset laces, fish lines, clothes lines, elastic braids, coverings for electric wires, and Rick-rack braids and other ornamental trimmings.

Braiding was introduced into the United States from Germany in 1824, and upon the perfection of braiding machinery in this country the industry developed rapidly. For some years Rhode Island has been the center of the braiding industry in the United States.

E. J. G.

**BRAIDWOOD, THOMAS** (1715-1806), Scotch educator, was born in Scotland in 1715. After graduation from Edinburgh University, he became a school teacher, and in 1760 opened in Edinburgh, a school for the deaf and dumb, the first institution of its kind in Great Britain. In 1783 Braidwood's school was given a royal grant of 100 pounds yearly and moved to Hackney, near London. His family carried on his system of teaching for many years after his death, Oct. 24, 1806.

**BRAILA**, a city of RUMANIA, capital of the department of the same name, built on the west bank of the Danube, 104 mi. from its mouth, Sulina, in the Black Sea. The Danube has three mouths, Kilia, Sulina and St. George. Braila is the chief Rumanian port for the export of grain and is otherwise a lively commercial city. Its port has accommodations for a large number of vessels and the quays stretch for miles along the bank of the Danube. There are immense warehouses for grain, but there are no particularly noteworthy buildings, except a cathedral. Five miles distant is Lake Sarat, from which salt, sulphur and iodine are extracted. Pop. 1930, 68,310.

**BRAILLE, LOUIS** (1809-52), French teacher of the blind, was born at Coupvray, near Paris, Jan. 4, 1809. He became blind at three years and at 10 entered the Institution des Jeunes Aveugles at Paris, where he became professor in 1826. Braille invented a system whereby the blind could read and write by using an alphabet consisting of different combinations of six tangible dots. He died at Paris, Jan. 6, 1852.

**BRAILLE SYSTEM: Printing for the Blind.** See BLIND, CARE AND WELFARE OF THE.

## CRANIAL NERVES

**BRAIN**, the enlarged head end of the central nervous system which is primarily a center for the important nerves of the head, and which, increasing in complexity and importance in higher forms of life, becomes the central exchange of nervous impulses throughout the body, correlating their messages, originating responses, storing impressions for future possible use, and finally becoming the seat of the intelligence.

Since, as the animal moves along, the head end is the first portion of the body to come into contact with the environment, the sensory structures in this region become important for its safety and for the procuring of food. The connections of the nerves here accordingly enlarge. In most animals there are twelve pairs of these *cranial nerves*, each with a

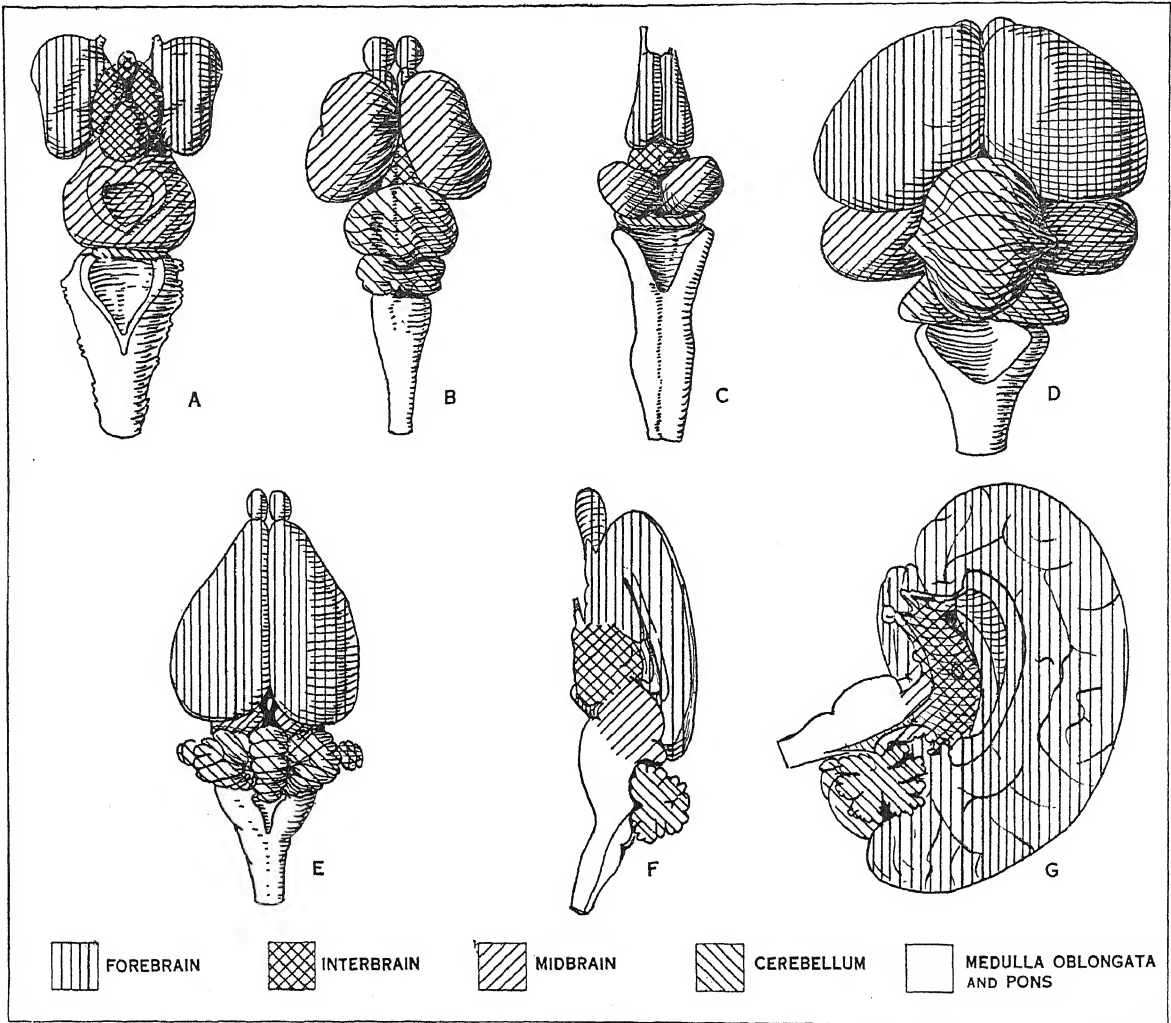


FIG. 1. BRAINS OF REPRESENTATIVE ANIMALS, WITH THE CHIEF DIVISIONS INDICATED BY LINES OF DIFFERING DIRECTIONS  
A, lamprey cel; B, bony fish; C, frog; D, pigeon; E, rat; F, rat; G, man. A-E, dorsal view; F and G, mid-line section

The structural basis and unit of all this complicated activity is the nerve cell or neuron, which has long protoplasmic projections radiating from a central cell body. These projections are in contact with those of other neurons in such a manner that an elaborate network is formed. A group of these projections is termed a *NERVE* if it is outside the brain or spinal cord, and a *tract* if it is inside; a group of nerve cell bodies is likewise termed a *ganglion* if it lies outside the central nervous system, or a *nucleus* if it is inside.

different function. The nerves of the senses of smell, of vision, and of hearing and equilibrium are the most important. They form respectively the first, second, and eighth pairs. These nerves are purely sensory, but most other nerves carry both sensory and motor fibers. Primitively the lower face and neck are arranged as serial segments, a pair of cranial nerves supplying each segment. They are, in order, the fifth, seventh, ninth, and tenth. The sensory division of the fifth, or trigeminal, mediates sensation from the face and supplies motor fibers to the

muscles of the jaws. The sensory field of the seventh, or facial nerve, early becomes lost, but its motor fibers increase to supply the developing facial musculature. The ninth, or glossopharyngeal, and the tenth, or vagus, pass to the pharynx, larynx, and neck in general, the latter nerve continuing far into the trunk and supplying fibers which aid in regulating the heart and alimentary canal.

The other cranial nerves are relatively unimportant. The third, fourth, and sixth are motor to the muscles which move the eyes. The eleventh supplies certain muscles in the neck, while the twelfth innervates the muscles moving the tongue. Taste sensations are carried by the seventh, ninth, and tenth cranial nerves.

### MEDULLA OBLONGATA

The brain develops embryologically from the forward end of the hollow neural tube (*see* NERVOUS

EAR. Some vestibular fibers form reflexes within the oblongata (*see* Fig. 2 for all nerves and tracts), but the perception of position and balance is so important that a considerable projection to receive and classify such sensations develops on the upper aspect of the forward extreme of the oblongata, especially large in active animals. This is the cerebellum. Having become dominant in maintaining balance, another tract grows into it, which carries sensations of posture from the muscles and joints of the body, and passes up the side of the spinal cord (*spinocerebellar tract*). Provided thus with specialized information, the cerebellum projects tracts which control muscular contractions regulating stasis and posture. These outgoing fibers end at cell groups, still enclosed within the cerebellum, which in turn relay the impulses. Some fibers descend directly to the motor nuclei of the oblongata. Others, the *brachium conjunctivum*, pass forward and end at another group of cells, the *red*

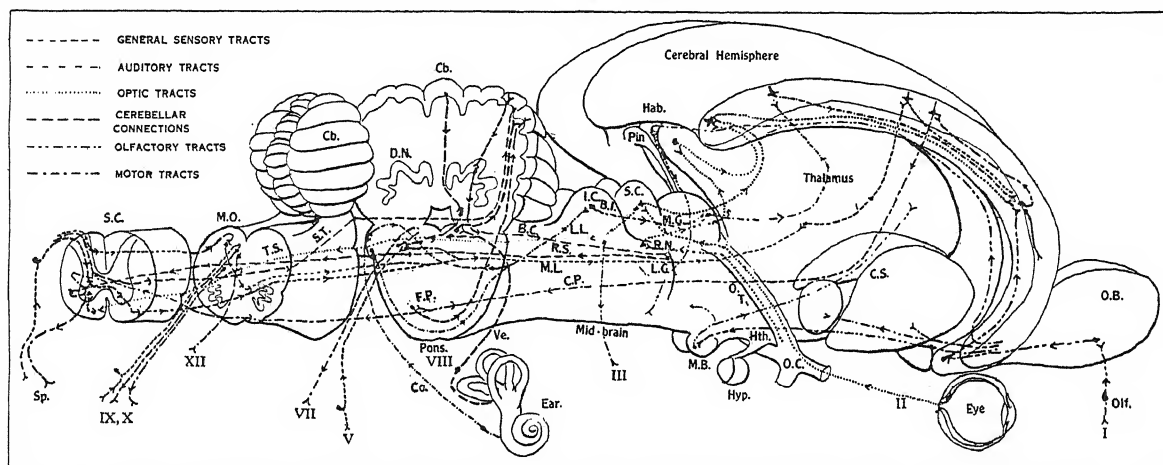


FIG. 2. SCHEMA OF THE MAMMALIAN BRAIN TO SHOW THE MAIN TRACTS AND NERVE CONNECTIONS

B.C., brachium conjunctivum; B.I., brachium of the inferior colliculus; Cb., cerebellum; C.O., cochlear root; C.P., cerebral peduncles; C.S., corpus striatum; D.N., dentate nucleus; F.P., frontopontine tract; Hab., habenula; Hpy., hypophysis; Hth., hypothalamus; I.C., inferior colliculus; L.G., lateral geniculate body; L.L., lateral lemniscus; M.B., mammillary body; M.C., medial geniculate body; M.L., medial lemniscus; M.O., medulla oblongata; O.B., olfactory bulb; O.C., optic chiasma; Olf., olfactory; O.T., optic tract; Pin., pineal body; R.S., rubrospinal tract; S.C., spinal cord; superior colliculus; Sp., spinal nerves; S.T., spinocerebellar tract; T.S., tectospinal tracts; Ve., vestibular root; I-XII, cranial nerves

SYSTEM). Five enlargements develop serially, each of which gives rise to a different portion of the brain. These portions are represented by different directions of crosshatching in Fig. 1. The fifth to twelfth cranial nerves enter the hindmost segment, the *medulla oblongata*, a small, elongated, slightly flattened structure, broader in front. The roof of the original neural tube is a thin membrane, but the floor is greatly thickened for the connections of the nerves which enter it. The cavity of the tube is the flattened, rhomboidal, *fourth ventricle*. Within the oblongata the nerves make secondary and reflex connections which relay impulses to other nerves and to higher centers.

### CEREBELLUM

The eighth nerve has two roots: vestibular and cochlear. The *vestibular root* conducts sensations of equilibrium from the semicircular canals of the inner

nucleus. The neurons of the red nucleus receive impulses from other regions further forward, and correlating these impulses from various sources, emit the *rubrospinal tract* which descends the spinal cord and terminates at the nerve cells along it which directly control the muscles. In mammals, when a more forward part of the brain becomes dominant in controlling the muscles (cerebral cortex), the *frontopontine tract* is sent down to nuclei below the cerebellum, collectively called the *pons*, which structure relays these stimuli to the cerebellum. The pons forms a considerable projection on the lower surface of the oblongata (Fig. 5, *Po.*).

The *cochlear root* of the eighth nerve, which receives sound vibrations, begins at the cochlea of the ear and ends in nuclei at the periphery of the medulla. Auditory impulses are continued forward into the midbrain by the *lateral lemnisci* which end at the inferior colliculus or *inferior quadrigeminal*



body (Fig. 5, I.C.). Another link of the auditory chain of neurons, the *brachium of the inferior colliculus*, relays these impulses further forward to the *medial geniculate body*, whose cells send fibers to the cerebral cortex, where sound is perceived and interpreted. At these way stations, sound reflexes are established and the impulses are modified or correlated with others.

### MIDBRAIN

The midbrain contains the *nuclei of origin of the third and fourth nerves*, the *red nucleus*, and the *inferior colliculus*, and transmits several great bundles to other regions (*cerebral peduncles*, *medial lemniscus*). But the most important constituent, especially in lower forms, is the *optic tecti*, or *superior colliculi* (Fig. 5, S.C.). Here terminate many fibers of the optic nerves after they have partially crossed at the *optic chiasma* below the brain. From the tecti, the *tectobulbar* and *tectospinal tracts* descend. They associate movements with ocular impressions. In higher forms, most of the visual impulses pass instead to the *lateral geniculate bodies*, situated near the superior colliculi, and are transmitted forward to the cerebral cortex. Here they are correlated to form visual images which, by fibers radiating to other parts of the cerebrum, are associated with other higher centers.

In the lowest forms, the midbrain and oblongata, with their cranial nerves and reflex connections, constitute the greater part of the brain (except for olfactory connections). But all higher forms have a segment forward of the midbrain which furnishes an important center of higher correlation of these nervous impulses, and adds a quality of feeling or sensation to that of reflex or automatic activity. This is the *interbrain*, composed chiefly of the *thalamus*. In higher forms the thalamus acts largely as a way station for ascending impulses to still higher centers.

### FOREBRAIN

Thus far all the cranial nerves have been accounted for except the *first or olfactory* pair. These enter at the forward extreme of the brain, far from the other nerves. Consequent on the importance that sensations of smell play in the life of lower animals, they are destined to exert a powerful influence on the trend of the evolution of the brain. The nerves coming from the nose terminate in the stalked olfactory bulbs and are passed on to the brain by the olfactory tracts. They then diverge in groups to a number of centers, with a variety of connections and types of organization. The *habenula*, above the thalamus, makes olfactory connections with the cranial nerves in the oblongata. The *hypothalamus*, below the thalamus, is created a center for olfacto-motor reflexes, but in higher forms its olfactory connections dwindle and the region becomes transformed into one for the control of the vital activities of the body. These centers are in the *interbrain*, but all other olfac-

tory centers are in the *forebrain*, the most forward segment of that organ. An increased field for correlation becomes necessary, in response to which need a hollow bulb or vesicle forms on either side of the forward extreme of the brain tube. A section across

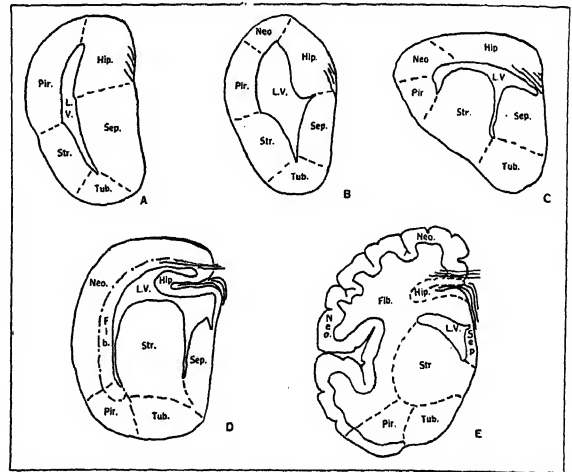


FIG. 3. SEMI-DIAGRAMMATIC CROSS SECTIONS OF THE FOREBRAINS OF REPRESENTATIVE ANIMALS

A, shark; B, frog; C, turtle; D, rat; E, man. Fib., fibers; Hip., hippocampus; L.V., lateral ventricle; Neo., *neopallium*; Pir., *piriform cortex* (olfactory); Sep., *septum* (olfactory); Str., *striate body*; Tub., *olfactory tubercle*.

the forebrain vesicle shows it to be divided into quadrants: *septum*, *striatum*, *hippocampus* and *piriform cortex* (Fig. 3, A.). The *striatum*, at first purely olfactory, enlarges when other tracts grow into it from lower centers, and it becomes a center for cor-

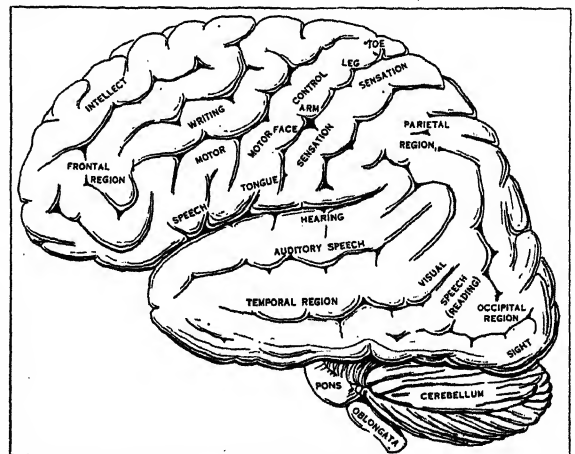


FIG. 4. LOCALIZATION OF FUNCTIONS IN THE BRAIN

relation of all nervous impulses, an important strategic addition to the circuit. In reptiles and birds the striatum constitutes the bulk of the brain, and controls the complex instinctual activities of these animals. But owing to the basis plan of connection of its neurons, only stereotyped activities result.

A small region in frogs between the piriform area and the hippocampus whose functional structure per-

mits a greater variety of correlation also makes connections with other nerve centers and develops enormously in mammals (*C.D.*). This is the general *cerebral cortex* or *neopallium*. In man it far outstrips other parts of the brain in development, and constitutes a great field for the elaborate association of all kinds of impulses, from which are developed complex manual movements, reading, writing, speech,

become of such paramount importance in muscular control that other motor tracts dwindle.

The great bulk of the human brain (Fig. 5) is forebrain, composed principally of the much convoluted *cerebral cortex*, and enclosing a fairly large *striatum*. The *corpus callosum* (*C.C.*) connects the cerebral hemispheres of opposite sides. The *third ventricle* (*T.V.*) represents the flattened terminal por-

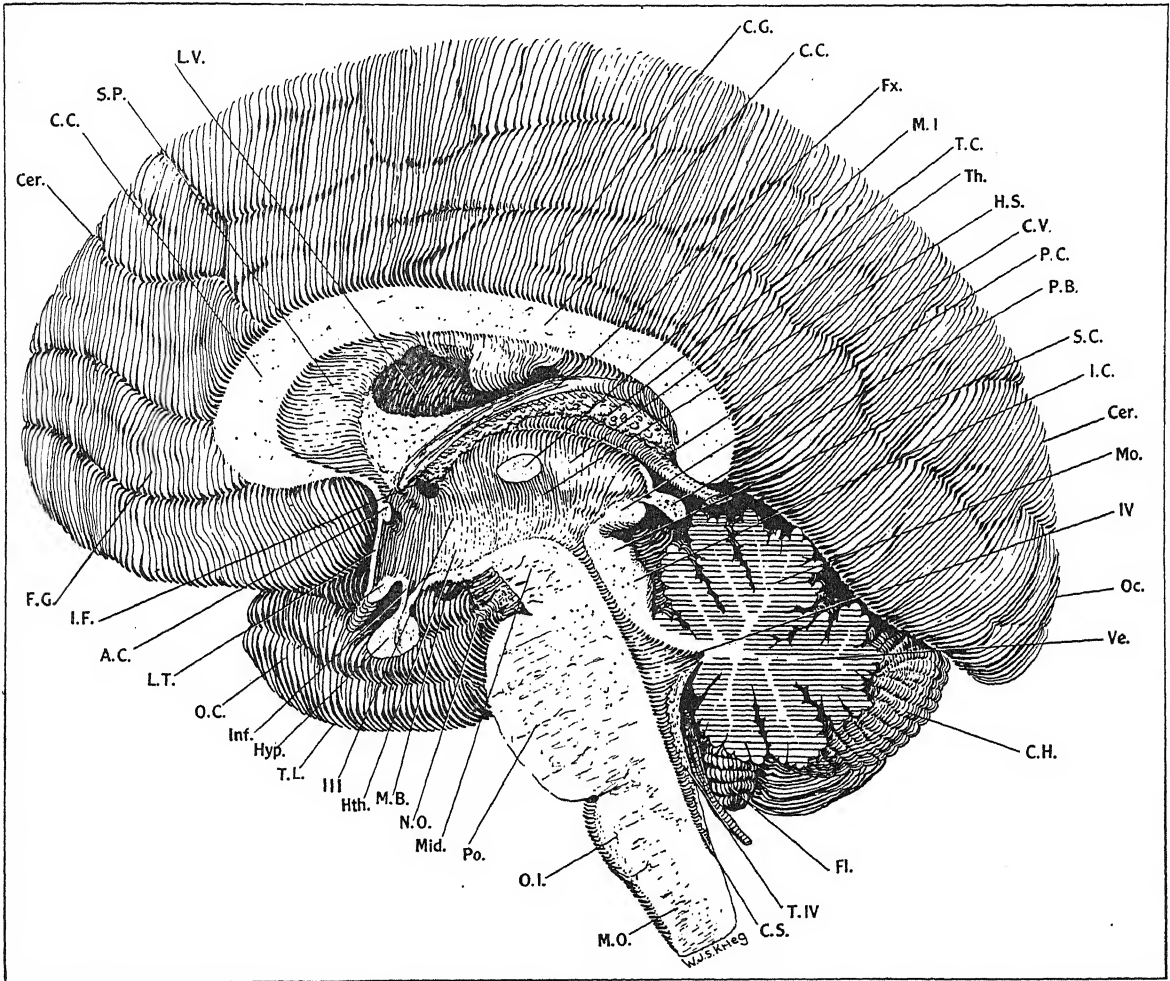


FIG. 5. SECTION OF THE HUMAN BRAIN THROUGH THE MID-LINE

A.C., anterior commissure; C.C., corpus callosum; Cer., cerebrum; C.G., cingulate gyrus; C.H., cerebellar hemisphere; C.S., calamus scriptorius; C.V., great cerebral vein; F.G., frontal gyri of cerebrum; Fl., flocculus; Fx., fornix, with choroid plexus of third ventricle below; H.S., hypothalamic sulcus; Hth., hypothalamus; I.C., inferior colliculus; I.F., interventricular foramen; Inf., infundibulum; L.T., lamina terminalis; L.V., lateral ventricle; M.B., mammillary bodies; M.I., massa intermedia; Mid., midbrain; Mo., monticulus of cerebellar vermis; M.O., medulla oblongata; N.O., oculomotor nerve; O.C., occipital pole of cerebrum; O.C., optic chiasma and nerve; O.I., inferior olive; P.B., pineal body; P.C., posterior commissure; Po., pons; S.C., superior colliculus; S.P., septum pellucidum; Th., thalamus; T.L., temporal lobe; T.IV., choroid plexus of fourth ventricle; III, third ventricle

reflection and judgment, thus distinguishing the nervous activity of man from that of lower animals.

In the evolution of the cerebral cortex, certain regions early become associated with tracts of specific functions. These are localized in the human brain in Fig. 4. Most of these areas are sensory, but the mammals progressively develop a region for the higher control of the muscles (*motor area*). The cells of this area send long tracts (*pyramidal tracts*) down to the ultimate motor neurons of the spinal cord which

tion of the neural tube, while the horseshoe-shaped *lateral ventricles* within the cerebral hemispheres are the attenuated remains of the cavity of the forebrain vesicles. The *cerebellum* (*Cb.*) is also very large and may be recognized by its arbor-vitae-like structure in section. Other structures are evident from the labelling of the figure.

See also NERVOUS SYSTEM; SPINAL CORD; NERVE; NEUROSURGERY; APOPLEXY; CEREBRAL HEMORRHAGE; SKULL. W. J. S. K.

**BRAINERD**, a city in central Minnesota, the county seat of Crow Wing Co., situated on the Mississippi River, 128 mi. northeast of Minneapolis. Two railroads and bus lines afford transportation. There is an airport. The Cuyuna Range runs through this point. Iron was discovered here in 1906, and Brainerd is now the center for a great iron-mining region in which there are over 40 mines. Farming is important in the surrounding region. The city has railroad shops, a paper mill, a garment factory, concrete works and saw mills. In 1929 the retail trade reached a total of \$5,901,522. Brainerd was founded in 1870 and chartered in 1883. Pop. 1920, 9,591; 1930, 10,221.

**BRAINTREE**, a town of eastern Massachusetts, in Norfolk Co., situated 10 mi. south of Boston. The New York, New Haven & Hartford railroad and bus lines afford transportation. Braintree is mainly a residential district of Boston, but it has manufactures of shoes, rubber, flooring and woodwork. In 1929 the retail trade amounted to \$3,653,318. The town was founded in 1640 and, before its present boundaries were laid out, contained the birthplaces of John Adams, John Hancock and John Quincy Adams. Pop. 1920, 10,580; 1930, 15,712.

**BRAKE** or **BRACKEN** (*Pteridium aquilinum*), one of the most abundant and widespread ferns, found in nearly all parts of the world. It has a long, black, perennial rootstock, which creeps extensively, sending up each season numerous stems, each of which divides at the top into three main branches bearing the leafy portion. The plant usually attains a height of 2 to 4 ft., often covering large areas in districts with sterile soil. The dried fronds are used for thatch and litter and sometimes for fodder.

**BRAKES** for vehicles, devices for retarding or stopping motion by the application of friction, directly or indirectly, to the wheels. On wagons or railroad rolling stock, the friction is applied at the rim of the wheel through segmental shoes. In the motor car, internal expanding brakes, external contracting brakes, or brake-shoes on the propeller shaft are employed, generally lined with asbestos or other heat resisting material, which increases the frictional drag against the brake-drum, and also prevents "squealing." Occasionally force is applied to the brake-shoe by straight mechanical methods, employing the lever or the screw to increase power at the expense of movement. In the most usual type of brake, e.g., for railroad trains, compressed air, a vacuum, steam under pressure, or a combination of these is used to multiply the power supplied by the operator.

**Railroad Brakes** are at present practically all operated by compressed air, though in Europe some of the lighter equipment still has hand-actuated braking systems. Compressed air was first employed by GEORGE WESTINGHOUSE, the type in general use bearing his name. In his first design, the AIR COMPRESSOR, located on the locomotive, supplied air under pressure to the various brake cylinders that applied power to the brake shoes. But in long trains, the time consumed for the large volume of air necessary

to work the brake cylinders on the furthest cars frequently resulted in the rear cars "piling up" on those ahead, damaging them. In any case, it took too long to bring a train to a stop. As the result of further study, Westinghouse designed the so-called "automatic" air brake, in which an auxiliary reservoir, placed on each car, supplies the braking force. An ingenious triple valve at each reservoir connects it with the line carrying air from the main compressor, as well as to the brake cylinder. This valve works when the pressure in the air line from the locomotive is slightly reduced. A slight reduction of air line pressure, brought about by moving a control lever in the engine driver's cab, lets air from the auxiliary reservoir into the brake cylinder, setting the brakes. A movement of this lever in the opposite direction lets air into the air line, building up the pressure to normal, at which point the valve at the reservoir opens to the air line and allows the air-line pressure to establish itself in the auxiliary reservoir, thus releasing the brakes. A later improvement is the "quick-acting" automatic brake, which employs an improved form of triple valve that, in addition to letting air from the auxiliary reservoir into the brake cylinder, allows the air in the main line to escape to the atmosphere, thus speeding up the rate at which the reduced air pressure travels along the train, so speeding the setting of brakes on the more remote cars. Still more recent improvements involve the use of higher pressures in the air line, and the development of the electro-pneumatic type of brake. In this last design, which was developed for electric traction but is now used on all fast passenger trains of any great length, an electric control, actuated from the locomotive cab, is placed on each triple valve. This eliminates the time consumed in waiting for the reduced air pressure to reach the most remote car. The brakes on every car are set at practically the same instant, thus permitting sudden emergency stops. This type of brake can be worked either by the electric control, or as a conventional air brake.

**Regenerative Brake.** In electric traction, so-called "regenerative" braking is sometimes used. In this system, when the line current is cut off from the driving motors, they automatically become electric generators and force current back into the line against the impressed voltage of the line. Since the revolution of these motors working as generators consumes power, and since this power can come only from the momentum of the train, the motors, as generators, act as a drag on the train, or as brakes. The current generated is returned to the electrical system.

**Electro-Mechanical Brake.** In a few cases, electromagnets are used to apply brakes, solenoids being generally employed. But the ease with which an electric circuit may become disrupted tends to keep this system from general use in spite of its simplicity and the speed at which electric impulses travel. However, this type of brake is extensively used on ELEVATORS and hoisting equipment, the brakes being set by the pressure of a spring and being released by the force

of an electromagnet energized by an electric current. The design, however, does not allow of slow application of the braking force, as does the air brake. Its use is limited to those mechanisms which call for either full braking or full release.

**Motor Car Brakes** generally are worked from the unaided pressure of the driver's foot on the braking system, though foot pressure may be supplemented by the force of compressed air—stored in a tank on the chassis—or by the partial vacuum existing in the intake manifold. See INTERNAL COMBUSTION ENGINES. Originally motor vehicles were braked only through their rear wheels, though occasionally a brake was located on the propeller shaft. With the exception of a few motor buses or trucks, propeller shaft braking has now been abandoned. Brakes are usually placed on all four wheels. Emergency brakes, to hold a car when it is "parked," are separate from service brakes, being external contracting whereas the service brakes are internal expanding. A motor car brake having considerable popularity is the hydraulic type, wherein pressure is applied to all brake cylinders by a foot application of pressure on a piston working in a hydraulic accumulator (see ACCUMULATOR, HYDRAULIC). The chief drawback to this type of brake is that it is essential always to have the system filled with liquid to assure dependable working.

**BRAMANTE, DONATO** (1444-1514), Italian architect and painter, was born at Fermignano, Duchy of Urbino, in 1444. He studied painting under Piero della Francesca and in later life under Mantegna, and architecture under Luciana da Laurana. In 1472 he settled in Milan where he steeped himself in the brick Romanesque of Lombardy so thoroughly that he produced perhaps its crowning masterpiece, the church of Santa Maria delle Grazie in Milan. His many other buildings in Milan soon caused his style to spread over most of northern Italy and so increased his fame that in 1499 or 1500 he was called to Rome under the patronage of Cardinal Caraffa. At about this time Bramante's technique underwent a profound change: instead of building in Romanesque he turned to Renaissance and designed the chapel of San Pietro in Montorio, 1502, the cloister of Santa Maria della Pace, 1504, and the choir of the church of Santa Maria del Popolo, 1509. In 1506 Bramante came under the patronage of Pope Julius II and for him designed the rearrangement of the Belvedere about the Vatican; only a little of his work there now survives. He later undertook the reconstruction of St. Peter's, planning to erect the building on the design of a Greek cross with a great dome at the crossing but he died before the work was far advanced and later architects, in particular Michelangelo, radically modified his design. Bramante may be said to have spread the Renaissance style in Italy, in that while he never became one of its masters, he found it the cult of small schools and left it the great standard of Italy. He died at Rome, Mar. 11, 1514.

**BRAMBLE**, a name applied in a wide sense to all thorny shrubs of the blackberry and raspberry genus

(*Rubus*), but especially to the Old World blackberry (*R. fruticosus*) and its numerous varieties or allies. See also BLACKBERRY; RASPBERRY; RUBUS.

**BRAN**, ground outer coats of seeds of grains obtained in manufacture of flour or meal. Wheat bran is used extensively, but was formerly consumed chiefly as stock food. It is now manufactured in refined, palatable form and widely used for human consumption.

Bran is marketed as a flour and as a ready-to-eat cereal. The cereal (see CEREALS) is manufactured in flake and shred form and in varying bran-strengths. In either form, bran is used in making muffins, breads, etc.

Bran has certain laxative properties, due chiefly to its bulk which stimulates intestinal peristalsis. It is also an excellent source of iron, phosphorus, and vitamin B. See VITAMINS IN FOODS.

**BRANCH BANKING**, that type or form of bank organization in which the bank conducts or operates branches or offices at locations other than at the head office as distinguished from the unit system of banking where the banking business is done through one office. Under the branch system, as in the unit system, there is one corporation with a central management to which all branches or offices must report. It is customary for the head office or central management to issue one consolidated statement including all Assets and liabilities of the various offices.

Branch banking was common in the United States prior to the Civil War. In fact it dates back to the FIRST BANK OF THE UNITED STATES which was established in 1791. The NATIONAL BANK ACT, passed in 1863, made no provision for branch banking. For a number of years thereafter there was a tremendous growth in the number of unit banks. That condition prevailed until about the end of the last century after which there has been an increasing interest in branch banking. This interest has manifested itself in certain changes in national and state banking laws, in official opinions and judicial decisions.

On June 30, 1930, 817 banks were operating 3,618 branches. Of these branches 2,470 were located within the city of the parent institution, and 1,148 were located outside the corporate limits of the city of the parent institution. In 1931 nine states and the District of Columbia permitted state-wide branch banking, whereas the majority of the state laws that permit branch banking in any form restrict it to the city of the parent bank. Maine permitted banks to establish branches in the adjoining county, while Tennessee restricted it to the county of the parent institution, and Louisiana to the parish. The National Bank Act limits national banks in two ways, first to the states which permit state banks to operate branches, second, the branches must be located within the city of the parent institution. Branch banking is popular in New York, Cleveland, Detroit, San Francisco, Los Angeles, Philadelphia, Boston, New Orleans, and Buffalo. California is the outstanding example of state-wide branch banking.

Branch banking has assumed great importance in banking discussion in recent years in this country, due in part to the more general recognition of the fundamental principles involved, and also to the large number of bank failures and the decreasing profits. To many banks, branch banking offers a solution for this difficult banking problem. With a decreasing number of unit banks, branch banking offers a method whereby banking facilities may be provided for many communities which would otherwise be without banking facilities.

The objections usually made against branch banking are that it tends toward monopoly; it will not serve local communities as well as unit banks; it is un-American; it tends to draw funds into the large cities. The principal advantages are the shifting of funds from one community where they are not needed temporarily to another where they are; economies of operation; the securing of better management; more uniformity in interest rates; more profitable to stockholders; lessening of the number of bank failures. See also CHAIN BANKING.

J. M. C.

**BRANCUSI, CONSTANTIN** (1876- ), Rumanian sculptor, was born at Pestisani-Gorque, Rumania, in 1876. He studied at the Ecole des Beaux Arts, and soon made a name for himself among the foremost of modern sculptors. Among his works are *Anatomical Figure* in the Ecole des Beaux Arts, *Bird in Flight*, *Suffering*, *The Kiss*, *Mlle. Pogany*, *Maiastira*, *Penguins*, *Yellow Bird*, *Chimera*, *Adam*, *Eve*, *Prodigal Son*, *Socrates* and *Bird in Space*.

**BRAND**, a term having the same meaning as trade mark (see TRADE MARK) without the legal limitations of the latter term. Any name, symbol, or device adopted by a maker or trader to identify his goods may be termed a brand. If it possesses the legal requirements of a trade mark it may receive legal protection as such. Otherwise the owner must rely upon the general laws against unfair trading for legal protection against imitators.

A name or symbol which is descriptive, geographical, or otherwise ineligible for legal recognition and protection as a trade mark may by long usage become recognized by the purchasing public as applying to a particular product or to the goods of a certain manufacturer. Persons who imitate or steal the name or symbol will then be held guilty of unfair trading.

The practice of branding goods is of very respectable antiquity, such marks having been found on bricks in the ruins of ancient Babylon, and on relics of ancient Greek pottery. Brands attained a considerable usage among the Romans. The practice achieved its true importance in merchandising, however, only within recent years. A very high percentage of the goods now distributed are sold under brand.

The brand enables the manufacturer or trader to attach to each unit of his product the GOOD WILL developed by his ADVERTISING or by the quality of the product itself. It also offers the purchaser some assurance of the quality of the goods he buys and gives

him, to some degree at least, a guide in buying.  
R. S. A.

**BRANDEIS, LOUIS DEMBITZ** (1856- ), American jurist, was born at Louisville, Ky., Nov. 13, 1856. He studied at the University of Louisville and the Annen Realschule, Dresden, Germany, graduated from the Harvard Law School in 1877, and was admitted to the bar in 1878. Practising law in Boston from 1878 to 1916, he took special interest in labor legislation, acted in several Interstate Commerce cases, and was special counsel for the Government in the Riggs National Bank case in 1915. He was chairman of the Arbitration Board in the New York garment-workers' strike of 1910 and was active in Zionist affairs. In 1916 President Wilson appointed him Associate Justice of the United States Supreme Court.

**BRANDENBURG**, formerly a mark and electorate of the Holy Roman Empire; since 1815 a province of Prussia. Geographically Brandenburg includes Berlin; but politically the latter forms a separate administrative unit. The area of Brandenburg, without Berlin, is slightly in excess of 15,000 sq. mi., and its population was estimated in 1925 at over 2,611,000. The land is flat, contains over 600 lakes, and is so sandy that the region for centuries was known as the "sandbox of the Holy Roman Empire." The sterility of the soil, and the presence of considerable quantities of brown coal, has made the people turn to industry, and great progress has been made in this sphere.

At the beginning of the Christian Era Brandenburg was inhabited by the Semnones and other Teutonic tribes; but these gradually were driven out or subdued by such westward migrating Slavic tribes as the Wends. Charlemagne accordingly found it necessary to establish a number of marks along the Elbe in order to protect his borders against these Slavic invaders. In 927 Emperor Henry I defeated the Havelli and captured their stronghold at Branibor (*brani*, war, and *boru*, forest), whence the names of the city and province of Brandenburg are derived. Emperor Otto I organized Brandenburg into a margravate and assigned it to Gero, who also controlled the Saxon east mark. It was at this time that the final subjugation and Christianization of the Slavic inhabitants took place.

About 1140 Albert the Bear (founder of the Ascanian family, so-called from a Latinization of the name of their ancestral castle at Aschersleben) became margrave of Brandenburg. He made strenuous attempts to colonize the region with Germans from Westphalia and the Netherlands. For the next 200 years the Ascanian family increased the size of the margravate and built up its power so that it came to include large parts of Pomerania, Bohemia and Poland. The joint rule of the brothers John I and Otto III in the middle of the 13th century was conspicuously successful, especially in the reduction of the power of the truculent nobles and in the building of cities. When the family died out in 1320 the land came under the control of Wittelsbachs and Luxemburgs until 1411, and it fell back into a



sloth of feudal anarchy and violence. During this time, however, by the Golden Bull of Emperor Charles IV, 1356, Brandenburg was made an electorate of the empire.

In 1415 Emperor Sigismund appointed Frederick of Hohenzollern, Burgrave of Nuremberg, to be Elector of Brandenburg, and from this event dates the remarkable rise of the province. The Hohenzollern rulers almost without exception did all in their power to restore and maintain order, put down the nobility, foster trade and industry, encourage town life, reclaim the land, and increase the territorial expanse of the heritage. About 1540 Lutheranism was introduced, and thereafter Brandenburg became one of the leading Protestant states in the Germanies. In 1618 the Elector John Sigismund became Duke of (East) Prussia through marriage, and also acquired the areas of Cleves, Mark and Ravensberg.

During the THIRTY YEARS' WAR Brandenburg suffered much from constant fighting and invasion, and its population was reduced from about 330,000 to some 140,000. Yet the diplomatic ability of Frederick William, the Great Elector, 1640-88, was such that Brandenburg emerged from the conflict and the peace negotiations at Westphalia enriched with a large part of Pomerania, and the sees of Halberstadt, Minden and Magdeburg. Thenceforth it was the aim of the Hohenzollerns to acquire as many of the territories which intervened between their scattered possessions as possible. The Great Elector's son, the Elector Frederick III, in return for aiding the Holy Roman Emperor in the WAR OF THE SPANISH SUCCESSION was rewarded with the right, 1701, to take the title Frederick I, King in Prussia. W. C. L.

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**BRANDENBURG**, a German manufacturing city located in the state of Brandenburg on the Havel River about 41 mi. west and south of Berlin. As *Brennabor*, it was once the chief fortress of the Slavic Havelli. It was acquired by Albrecht the Bear of Ascania, who made himself margrave of Brandenburg. It was the seat of a bishopric from 949 to 1544 and the most prominent city in the marches. It has noteworthy medieval buildings. The cathedral is on an island in the river. Originally a late-Romanesque brick basilica of the early 13th century, it was converted to Gothic style upon being rebuilt in the 16th century. St. Katherine's Church, built in the early 15th century, is one of the finest late-Gothic brick buildings. In 1415, Emperor Sigismund granted Brandenburg to Frederick of Hohenzollern, and it became the nucleus of the Prussian kingdom. Brandenburg has automobile and cycle works. Pop. 1925, 60,953.

**BRANDES, GEORG MORRIS COHEN** (1842-1927), Danish critic, was born in Copenhagen, Feb. 4, 1842. In the university he turned from jurisprudence to aesthetics and philosophy, and in 1862 won high regard with an essay, *The Nemesis Idea Among the Ancients*. When, in 1871, he became reader in Belles Lettres in Copenhagen University,

he was already recognized as one of the outstanding literary critics of Europe; but when the professorship became vacant in 1872 it was not offered to him, because of his radicalism. Instead, the chair was held vacant for 30 years, until Brandes was at last asked to fill it in 1902. In the intervening years he had published many important volumes. His study of Shakespeare, 1897-98, was translated by William Archer. Other important works are his critical biographies of Anatole France, Goethe, Voltaire, Heinrich Heine, and *Main Currents in 19th Century Literature, Creative Spirits of the 19th Century* and *The Jesus Myth*, 1925. Brandes died in Copenhagen, Feb. 19, 1927.

**BRANDON**, the second largest city of Manitoba, Canada, situated 133 mi. west of Winnipeg, on the Assiniboine River. Because of its position in a great agricultural belt, grain-milling is of first importance. The Manitoba Provincial Exhibition, an agricultural fair, is held in Brandon every summer. Among numerous manufactures are agricultural implements, cheese and beer. The city has engineering works. Brandon includes Brandon College among several educational foundations. Originally a trading post, it was settled in 1881, and incorporated as a city in 1882. Pop. 1921, 15,397; 1931, 17,082.

**BRANDYWINE, BATTLE OF**, Sept. 11, 1777, an engagement of the REVOLUTIONARY WAR which resulted in the defeat of Gen. Washington with 11,000 Continental troops by a British army of 18,000 under Howe. Having been blocked by Washington in his attempt to march overland from New York against Philadelphia, the rebel capital, Howe undertook the same objective by sea. Finding the navigation of the Delaware obstructed, he disembarked his troops at Elkton, Md., late in August, intending to march overland to Philadelphia, 50 miles distant. Washington attempted to check the march at Chad's Ford on Brandywine Creek, about midway between Elkton and Philadelphia. The British presented an unassailable line, commanded by Gen. Cornwallis on the left, Howe in the center, and Gen. Knyphausen on the right. The American line, although commanded by Generals Greene, Wayne and Washington himself, was broken, with a casualty list exceeding 1,000. The British lost 500 men.

**BRANGWYN, FRANK** (1867- ), English painter and etcher, was born at Bruges in 1867. He studied under WILLIAM MORRIS. Among his large decorative works are mural paintings in the Royal Exchange, London, and in the courthouse at Cleveland, O. Many of his works are exhibited in museums at Paris, London, Munich, Stuttgart, Prague and at Pittsburgh, Pa.

**BRANT, JOSEPH** (1742-1807), Mohawk chief, was born in Ohio in 1742. He was given a good education by his patron, SIR WILLIAM JOHNSON, and joined the Episcopal Church. For a time he worked as a missionary among the Indians, for whom he translated the Gospel of St. Mark into Mohawk. He was commissioned in the British army, and

fought during the Revolution; afterwards he worked to keep peace between the Indians and whites, and was as effective a diplomat as he had been a warrior. Later he visited England, where he was received and honored by Burke and Sheridan. He died at his estate on the banks of Lake Ontario, Nov. 24, 1807.

**BRANT**, the common name for several rather small, dark-colored geese highly prized as game birds. The European brant (*Branta bernicla*), of which the common North American water brant (*B. b. urota*) is a variety, is about 2 ft. long with grayish brown plumage and black head, neck and breast, with a white spot on the side of the neck. It breeds in arctic regions and winters southward, chiefly along the Atlantic coast, to the Mediterranean in the Old World, and to North Carolina in the New. Marine in habit, this goose rarely ventures far from salt water and feeds chiefly upon eelgrass, insects and crustaceans, for which it wades at low tide. When found in flocks the brant is very noisy, uttering a loud honking note. It builds on the ground a grassy nest lined with down, laying 4 creamy-white eggs. The black brant (*B. nigricans*), with darker underparts and a larger white collar, occurs on the Pacific coasts of North America and Asia.

**BRANTFORD**, city, county seat and port of entry, in Brant Co., Ontario, Canada, situated on the navigable Grand River, about 57 mi. southwest of Toronto. Served by five railways, Brantford is the industrial center of an agricultural district, and manufactures agricultural implements, flour, cotton, wool, stoves and pulpwood machinery. It is a modern city of many fine schools, churches, 150 acres of park land, and an airport. It was once the home of Alexander Graham Bell. The city is named for Joseph Brant, the Mohawk Indian chief who migrated there during the American Revolution. Founded in 1818, Brantford was incorporated in 1847. Pop. 1921, 29,440; 1931, 30,060.

**BRANTING, KARL HJALMAR** (1860-1925), Swedish socialist leader, was born in Stockholm, Nov. 23, 1860. He acquired a reputation and influence as a socialist while editor of the *Social-Democrat* in Stockholm and came into world prominence during and after the World War both through his presence at socialist conventions and by his strong opinions on international policy. He was present at the VERSAILLES PEACE CONFERENCE in 1919 and advocated the adoption of WOODROW WILSON's peace program. In 1920 he became prime minister of Sweden, the first socialist to fill that office, and in 1921 he was awarded the Nobel peace prize. He died at Stockholm, Feb. 24, 1925.

**BRAQUE, GEORGES** (1881- ), French painter, was born at Argenteuil in 1881. At about 20, he was influenced by the Fauves (see FAUVISM), but turned to CUBISM, a movement in which he and PICASSO were the leaders. Braque became recognized as a master of technique, and his work, chiefly still-lives, reveals a natural sense of design and color. Among his important pictures are *Harlequin*, *Bottle and Glass*, *Guitar*, and *Still Life*, which is in the Museum of Modern Art.

**BRAS D'OR**, an arm of the sea penetrating the interior of Cape Breton Island. Its area is approximately 360 sq. mi. It consists of two lakes, a small one at the entrance which is separated by the Grand Narrows from the larger body in the interior.

**BRASOV** (Hungarian *Brasso*, *Kronstadt*), a city in southeast Transylvania, Rumanian since 1921, consists of the elongated Saxon old city, the factory sections and an upper suburb. There are a fine city hall, advanced schools, several museums and a library. The industry, facilitated by the lignite mines, produces chiefly cloth, machines, leather and ceramic wares. Pop. 1930, 58,000.

**BRASS** is commercially the most important alloy of COPPER. It is easily worked by drawing, spinning or turning into hardware, fixtures and many small articles, where ornament and general usefulness is required. Its composition varies from nearly pure copper with a fractional percentage of zinc to 57% copper, zinc remainder, and its natural color varies from the color of copper through a light pink at 85% copper, to a golden yellow at 80%, which becomes a full yellow at 70%, and a greenish yellow at 65% copper. From this point, with diminishing copper, the color again becomes reddish and at from 60 to 57% it closely resembles that of brass with 85% copper. Brass with more than 80% copper does not season or corrosion crack, nor will it dezincify except under extraordinary conditions, hence the extensive use of red brass 85% or rich low brass, where it must resist the action of corroding agents. Gilding contains 95% copper and 5% zinc, commercial bronze 90% copper, red brass 85% or rich low brass contains 85% copper, red brass 80% or low brass contains 80%, brazing brass 75%, cartridge brass 70%, drawing or spinning brass 66 2/3%, commercial or high brass 65% and Muntz metal 60% copper.

Additions of lead, tin and other metals are made to brass to obtain special properties. Lead gives it good machining or cutting qualities and tin increases the resistance of the alloy to the action of corroding agents. The various brasses have so many uses that it is difficult to prepare a general list. Depending upon color, ease of working, physical properties and resistance to the action of corroding agents, brass is used in jewelry, automobiles, hardware, plumbing, lamp fixtures, ammunition, bolts, screws, rivets, spring stock, clocks and a large variety of articles. See also BRONZE; BRONZE AND BRASS IN ART. W. H. B.

**BRASSEY, THOMAS** (1805-70), English railroad engineer, was born at Buerton, Oldford, Nov. 7, 1805. He participated in the construction of parts of the Grand Junction and the London & Southampton Railway, and in 1840, with his partner, W. MacKenzie, contracted to build a railroad from Paris to Rouen. Within a few years he was employing an army of 75,000 men for railroad-building, undertaking to lay tracks in Holland, Prussia, Spain, Italy, South America, Australia and India. He helped build the Grand Trunk Line of Canada, more than 1,000 miles in length, which also involved construction of the bridge

over the St. Lawrence River at Montreal. He died at Hastings, England, Dec. 8, 1870.

**BRATIANU, JON (ION, JOHN)** (1864-1927), Rumanian statesman, was born at Florica on August 20, 1864, the eldest son of the Liberal statesman Jon C. Bratianu who had established a record as premier of Rumania for thirty years. Following upon the completion of his studies at the Polytechnic School in Paris, young Bratianu, or "Jonel," as he was known, became an engineer on the Rumanian State Railways. In 1895 he entered parliament as a Liberal deputy, soon becoming Minister of the Interior in the government of M. Sturza. When the latter retired in 1909 Bratianu succeeded him both as head of the Liberal Party and as premier. He resigned in 1911 only to return to power in 1913 and remain at the helm during the critical days of the World War until January 29, 1918. Then he resigned rather than accept the terms imposed by Germany following Rumania's disastrous adventures in the war.

After the victory of the Allies Bratianu returned to the premiership, denounced the earlier separate peace, and became his country's chief delegate at the Paris Peace Conference (1919). However, in protest over the terms of the peace treaty which guaranteed the rights of minorities in Rumania and which awarded part of the Banat of Temesvar to Yugoslavia, Bratianu refused to sign the treaty. He maintained that Rumania was entitled to the entire Banat under the provisions of the treaty of 1916 which had brought the kingdom into the war. He also gave up his cabinet post and for several years headed the Opposition.

In January, 1922, Bratianu again formed a government, and except for a brief period in 1926 he now remained virtual dictator of Rumania until his death on November 24, 1927. He was ably supported in his policies by his brother Vintila who held the portfolio of finance. During these years much was done in the way of breaking up the large landed estates and of settling the Jewish question, and universal suffrage was extended in national elections. The Bratianus upheld the exclusion of Prince Carol from the throne and opposed his return to Rumania. Though really representing the business and commercial interests of the land, Bratianu was highly reserved and suspicious in his dealings with foreigners. He was particularly fearful of the influence of foreign capital and generally discouraged foreign investments and concessions in Rumania. Upon his death he was succeeded in the dictatorship for a year by Vintila. The latter then was removed through the temporary triumph of the National Peasant Party led by Juliu Maniu.

**BRATIANU, VINTILA** (1867-1930), third son of the Liberal Rumanian leader Jon C. Bratianu, studied engineering in France, returned to practice his profession in Rumania for a time, entered politics, and in 1909 became financial and economic adviser to the Liberal Party which was headed by his brother Jon. During the period of Rumania's participation

in the World War he was minister of munitions, and in 1922 he became finance minister in his brother's cabinet. This post he held for the next six years, though in 1927, upon the death of Jon, he also became premier. He was forced to resign the premiership late in 1928 to make way for a new National Peasant government under Dr. JULIU MANIU. Bratianu favored the interests of the commercial middle class, strove to make Rumania economically self-sufficient through a system of high tariffs and the fostering of domestic industries, placed the services and influence of the National Bank at the disposal of business, and fought the increasing power of foreign capital. He died at Miraeti on December 22, 1930.

**BRATISLAVA** (*Pressburg*), once the capital and coronation city of the Hungarian kings of the House of Hapsburg, since 1918 the capital of SLOVAKIA in the Czechoslovak Republic, picturesquely situated on the Danube at the foot of the Carpathian Mountains. It is a pleasant residential city with six public squares, 15 Catholic and two Protestant churches, seven abbeys and two synagogues. The splendid Gothic cathedral, 1221-1487, the Gothic Franciscan Church, 1297, and the Klarissa church are noteworthy. The chief secular buildings are the city hall, begun in 1288, the municipal museum, the buildings where the Hungarian parliament met 1802-48, and the palace of the primate. Economically the city's importance on the Danube is second only to Vienna. During the past 10 years Bratislava has developed the manufacture of textiles, iron and steel, chemicals, paper, wood products, industrial fats and grain products. Harbor facilities have been developed to such an extent that Bratislava will have a port capable of handling as much freight as is at present transported on all the waterways of the republic. More than half of the inhabitants are Czechoslovaks, the remainder Magyars and Germans. Pop. 1930, 123,852.

**BRATTLEBORO**, a village of Windham Co., Vt., on the Connecticut River, 60 mi. north of Springfield, Mass. It is served by the Boston and Maine and the Central Vermont railroads and by motor buses. Located in an agricultural, lumbering, granite, maple-sugar and dairying country, the town supports various industries. The most important of these is an organ works; others include printing and the manufacture of lumber products, cotton goods, paper, overalls, granite monuments, feeds and toys. Brattleboro is the center of a large hydroelectric development which furnishes power throughout New England. It is the seat of the Austine Institute for the Deaf, and of the Brattleboro Retreat. First settled in 1724, the village was organized in 1753, and named after William Brattle, one of the original patentees; incorporation took place in 1763. Naulahka, former home of RUDYARD KIPLING, is here; Larkin G. Mead, sculptor, lived in Brattleboro and it is also the birthplace of RICHARD MORRIS HUNT, architect, and WILLIAM MORRIS HUNT, artist. Pop. 1920, 7,324; 1930, 8,709; 20% foreign-born.

**BRAUN, KARL FERDINAND** (1850-1918), German physicist and specialist in wireless telegraphy, was born at Fulda, June 6, 1850. His researches into physics brought him professorships at the universities of Marburg, Strasbourg and Karlsruhe. In 1895 he was appointed director of the Physical Institute of Strasbourg. Braun's experiments in electrical fields resulted in improvements in radiotelegraphy, notably a method augmenting the power of a sending-station. With Marconi, in 1909, he was awarded the Nobel Prize for physics. He died at New York City, April 20, 1918.

**BRAWLEY**, a city in Imperial Co., southern California, situated 14 mi. north of El Centro and 135 mi. northeast of San Diego. It is served by the Southern Pacific Railroad, and by bus lines. There is a municipal airport. The largest city in the Imperial Valley, Brawley is 119 ft. below sea level, in a region once a desert but now highly productive, due to irrigation. The rainfall is less than 2 in. annually. The principal crops grown in the district and shipped through the city are cantaloupes, lettuce, vegetables of all kinds, and alfalfa. Considerable live stock is raised. The retail trade in 1929 reached a total of \$7,240,537. Brawley is the seat of a junior college. Salton Sea is 10 mi. north, and interesting geological formations are found in the vicinity. In 1901 the site of Brawley was occupied by a solitary Indian hut. In 1908 it was incorporated as a city. Pop. 1920, 5,389; 1930, 10,439.

**BRAZIL**, the largest republic in South America, bounded on the north by Colombia, Venezuela, the Guianas and the Atlantic Ocean; on the south by Uruguay, Argentina, Paraguay and Bolivia; on the east by the Atlantic and on the west by Argentina, Paraguay, Bolivia, Peru and Colombia. The official estimate of the area is 3,278,799 sq. mi.; some boundaries agreed upon are still undefined. In size, Brazil exceeds the United States, not including Alaska.

Brazil, ranking as one of the five great countries of the world in size, embraces about 45% of the total area of South America. Occupying the central portion of the continent, it borders all the political divisions of the continent except Ecuador and Chile. Its vast extent stretches from 5° 10' N. lat. on the south slope of Mt. Roraima to 33° 45' on the boundary of Uruguay, a distance of 2,691 mi. East and west it reaches for 2,600 mi. and has a coastline on the Atlantic of 4,106 mi.

**Surface Features.** The republic divides naturally into three main physical regions: 1. The eastern plateau occupying nearly one-quarter of Brazil, lying near the sea, with a hilly surface and mountainous in places; most of it can be used for crops or pasturage. 2. The basin of the AMAZON, low in elevation, hot at all seasons, deluged with tropical downpours and partly covered with dense forests. 3. The southern interior, largely, but not wholly lowland which consists more of grass lands than of forests, and lies mainly in the drainage basin of the PARANÁ-PARAGUAY river system. Along the sea for over 1,000

mi. the eastern escarpment of the eastern plateau rises almost from the shore. Its seaward edge appears like a range of mountains and has been named Serra do Mar. So steep is this escarpment that it is with great difficulty that two standard-gauge railways have surmounted the grades. A coastal plain of considerable width is found north of the 17th parallel. The highland of eastern Brazil is the redeeming physical feature of the country. Its surface averages about 2,500 ft. in elevation and is surmounted by ranges rising to 8,000 ft.

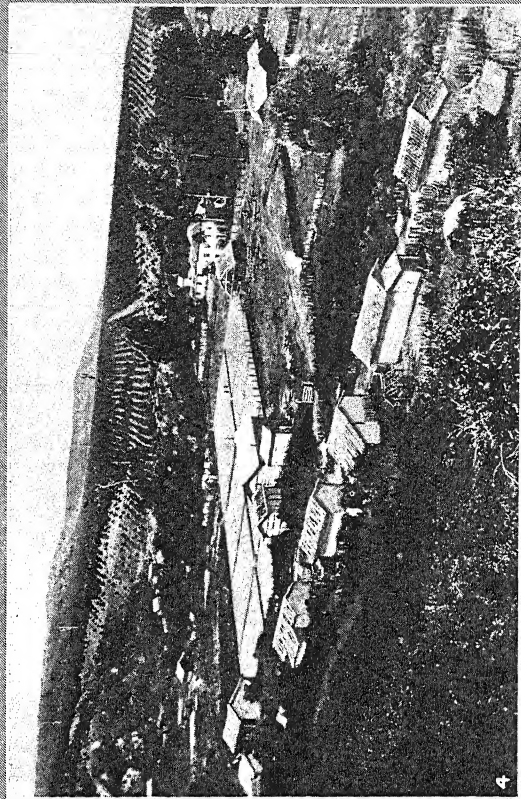
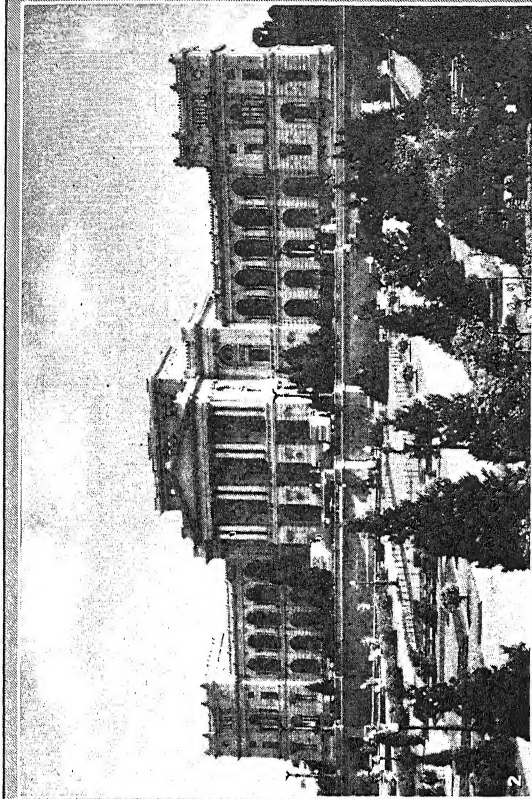
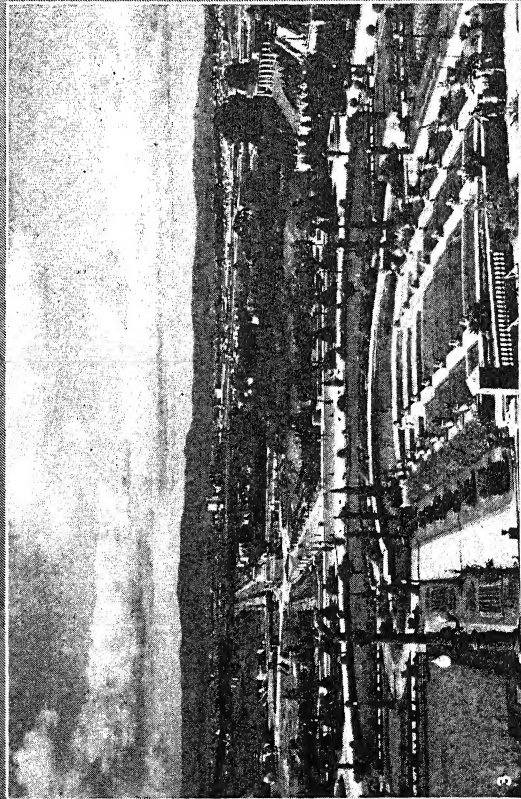
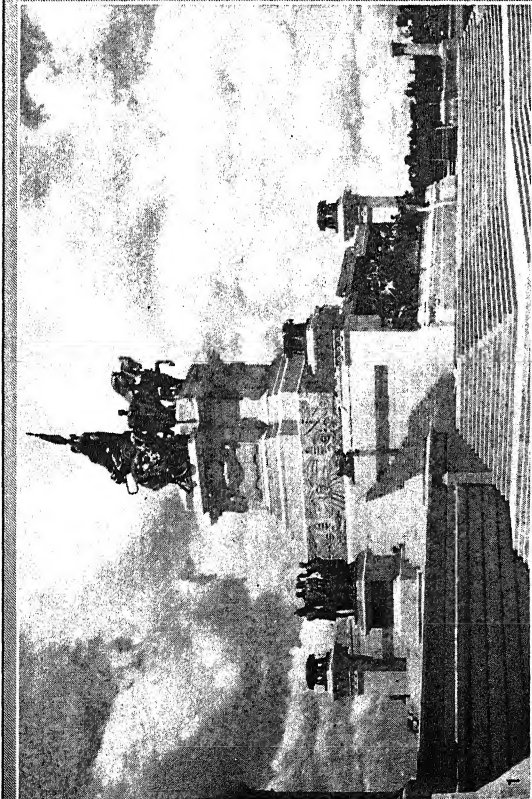
The total length of the innumerable rivers of Brazil has not been accurately estimated, due to the absence of a complete topographic survey, but some idea of its immensity may be gained from the fact that the navigable stretches total more than 40,000 mi. The rivers may be divided into three main groups; the Amazonian system, the rivers of the PLATE system and the eastern or coastal system. The Parahyba, Doce and the São Francisco flow into the Atlantic. Most of the rivers between the mouth of the Amazon and the estuary of the Plate, with the exceptions mentioned, are only minor streams, due to the fact that the highest ridges of the Brazilian plateau crowd down close to the sea and leave no space for the formation of great rivers.

**Climate.** The climates of Brazil are characteristic of those found in the low latitudes on the continental east coasts and interiors. Near the Equator, in the Amazon region and along the coast as far south as about 25° S. lat., the climate is hot and rainy. However, this type of climate is not uncomfortable where the easterly trade winds can be felt, as, close to the sea, or along the banks of the Amazon. In the interior, as one proceeds away from the Equator either northward or southward, the tendency becomes more marked for the year to be divided into a definite rainy season and dry season. In the northwest, the dry season is long enough to make severe droughts a menace. The southern states of Brazil enjoy a moderately rainy climate with mild winters, similar to the climate of the southeastern states of the United States.

**Inhabitants.** For three centuries Brazil was a Portuguese colony, and its eastern portion was settled by immigrants from Portugal. The language of the country is Portuguese; the traditions, ideals and social and political standards are inherited from Portugal. There are no reliable statistics on the proportion of whites, mulattoes and blacks. In the north, people who have Negro and Indian blood are greatly in the majority. In the states from Rio de Janeiro southward, people who are wholly white or nearly white predominate. In the interior, the sparse population is mainly Indian, or a mixture of Indian and white, with a possible further mixture of Negro blood. The vast majority of the colored people are poor and illiterate. In the southern half of the highland area and conspicuously in the region of São Paulo, European immigrants are numerous, and a much higher degree of energy is evident. The immigrants are



# BRAZIL



1. 2. COURTESY MUNSON STEAMSHIP LINE; 3. R. I. N-SMITH AND ASSOCIATES PHOTO; 4. COURTESY BRAZILIAN AMERICAN COFFEE PROMOTION COMMITTEE

## SÃO PAULO, CHIEF CITY OF THE COFFEE-PRODUCING REGIONS OF BRAZIL

1. Independence Monument on the plain of Ypiranga, São Paulo, commemorating the declaration of Brazilian independence there, Sept-7, 1822.
2. Museum of Ypiranga, São Paulo, of which the city of São Paulo is the capital.
3. View from the Museum of Ypiranga.
4. Coffee plantation in the state of São Paulo.





mainly Italians, Portuguese and Spaniards, but Germans, Slavs and other Europeans and some Asiatics are included.

The census of 1920 gave a population of 30,635,605; an official estimate in 1930 was 40,272,650. The population of the 20 states, Federal district and Territory of Acre is as follows:

States	1920	1930 (Est.)
Alagoas	978,748	1,189,214
Amazonas	363,166	433,777
Bahia	3,334,465	4,135,894
Ceara	1,319,228	1,626,025
Espirito Santo	457,328	661,416
Goyaz	511,919	712,210
Maranhão	874,337	1,140,635
Matto Grosso	246,612	349,857
Minas Geraes	5,888,174	7,442,243
Pará	983,507	1,432,401
Parhyba	961,106	1,322,069
Paraná	685,711	974,273
Pernambuco	2,154,835	2,869,814
Piauhy	609,003	809,508
Rio de Janeiro	1,559,371	1,996,899
Rio Grande do Norte	537,135	738,889
Rio Grande do Sul	2,182,713	2,959,627
Santa Catharina	668,743	948,398
São Paulo	4,592,188	6,399,190
Sergipe	477,064	547,965
Federal District	1,157,873	1,468,621
Acre Territory	92,379	113,725
Total	30,635,605	40,272,650

**Religion and Education.** The great majority of the people are Catholics, but many of the immigrants are Protestants. Complete religious toleration prevails.

Higher education is the privilege of the very few, 80% of the total population, mainly in the rural districts, being unable to read and write. Education is making much headway in the southeastern part of the country. Primary education everywhere is free, but not compulsory, except in seven states. In such institutions as the University of Minas Geraes, McKenzie College and Granbury College the progress of higher education can be noted. A union of several independent faculties maintained by the Federal Government in Rio de Janeiro has created the University of Rio de Janeiro.

**Forest Industries.** There are three quite distinct forest areas. 1. The vast tropical forests of the Amazon basin. 2. A strip of originally heavy forest from 30 to 200 mi. wide, extending along the rainy eastern coast for a distance of 1,700 mi. Because of nearness to the centers of population, the forest strip has supplied a large part of the lumber cut in Brazil. 3. The pine forests of the southeast which cover approximately 100,000,000 acres. There are large stands of nearly unmixed pine, with mature trees averaging 80 to 120 ft. in height and attaining 4 to 6 ft. in diameter. From 100 to 125 million feet of Paraná pine are exported annually to Argentina and Uruguay.

The forest region where Brazil, Paraguay and Argentina meet is the native home of the tree that yields *Herva maté*, or Brazilian tea. Brazil produces

about 65% of the entire South American commercial supply of about 230,000 tons a year, but the best quality is grown in Paraguay. In the Amazon basin are 1,000,000 sq. mi. of forests through which rubber trees are scattered. Although the wild rubber industry of this region is about a century old, rubber did not figure prominently in Brazilian exports until about 1870. The exports increased from 10,000,000 lbs. in that year to 93,000,000 lbs. in 1912, the peak of the trade. Plantation rubber from the Far East began to enter the world market in significant quantities about 1909, but the Brazilian productions continued at about the same level for some years. At one time the price of crude rubber rose to \$3 a pound, yielding fabulous profits to the producers. Following the World War, prices of rubber declined below 20 cents a pound, and the Brazilian industry was nearly ruined. The \$78,000,000 exportation in 1912 dropped to \$6,000,000 in 1929. It is estimated that the Amazon rubber costs fully twice as much to place on the market as plantation rubber. The plantations now furnish about 97% of the world's supply.

**Agriculture.** Nearly three-fourths of the land has a tropical climate and about one-half is covered by tropical vegetation which man would have to fight endlessly if he tried to bring the land under cultivation. At present, only 20% of the country is divided into farms and only about 3½% is under cultivation. Brazil is in no sense a one-crop country, yet one industry, coffee-growing, means more to the international trade of the republic than all other branches of agriculture combined.

Coffee was introduced into Brazil during the 18th century, and into São Paulo state shortly before 1800. It spread rapidly, especially in São Paulo, until, in 1906, the world market for coffee was saturated. Brazil alone produces more than two-thirds of the world's annual crop, and the state of São Paulo upwards of one-half. The average annual crop is about 13,225,000 bags of 132 lbs. each. In 1928 production reached 19,300,000 bags valued at \$465,000,000. The rapid expansion of coffee-growing in the São Paulo region has been due to various causes, in addition to favorable physical conditions. The soils are porous and well-drained, the climate has a dry season for the harvest and is not too hot nor too cold. Destructive frosts are rare. The areas covered by suitable soils and otherwise favored by nature are so extensive that when land which has been under coffee for some years shows signs of exhaustion, it is either turned over to other crops, or is abandoned and fresh land is cleared for cultivation. The berries on each plant all ripen at the same time, so that the harvest can be carried out in a single operation, whereas in other regions several pickings are necessary. The coffee industry in São Paulo and elsewhere in Brazil has been materially fostered by the government's valorization schemes. In São Paulo the upper limit for coffee-growing is about 3,280 ft., and in general the best qualities grow close to this limit. The coffee plant is very sensitive to climate, being unable to bear frost or fierce, dry

heat. Drought affects coffee and it is injured by excessive rain.

Its ease of production and high degree of utility as food and feed render corn the second crop of the country, the acreage averaging four-fifths of that in coffee. Corn combines with rice, beans and manioc to form the food of the common people. Although Brazil ranks next to the United States as a corn-producing country, it raises only about one-twelfth as much. Manioc, also called cassava, is a native of Brazil; it grows vigorously in poor soil, yields very heavily with little labor, may be prepared for eating in a variety of ways and is one of the greatest of all starch-producers. Rice has furnished a profitable means for the diversification of agriculture. Although a small production of lowland rice characterizes coastal and river valley districts, upland rice is the larger crop.

Cotton has recently awakened much interest as a possible cash crop other than coffee. As grown in eastern Brazil, American upland cotton yields a one-inch fiber and suffers by comparison with the long-staple tree cotton of the northeastern part of the republic; nevertheless it provides an excellent crop for the coffee lands. The crop may be planted between rows of coffee trees, and in many districts its small labor requirements, as compared with coffee, favor its establishment as a principal agricultural product. The growth of the Brazilian cotton manufacturing industry, which has a large domestic market, further increases the value of cotton as a crop; but to attain considerable importance, methods of production and marketing must undergo much improvement.

In cacao production, Brazil holds second rank to the GOLD COAST. The average annual export of cacao beans is upwards of 150,000,000 lbs. a year, fully 80% of which comes from the state of Bahia.

The production and exportation of sugar has suffered from the sugar tariffs and subsidies of Europe and North America. Minor handicaps that restrict agricultural industries of the country, with the possible exception of coffee, are the inefficiency of the colored laborer and insufficiency of capital and of transportation.

Among the farm crops of Brazil, tobacco ranks about eighth; yet the country is one of the five leaders in tobacco production. The total quantity grown annually somewhat exceeds a good crop in Virginia, or one-eighth of the output of the United States.

**Livestock and Meat Industries.** In the less tropical parts of the country large numbers of cattle are raised. The cattle lands are mainly in the cooler southern states or on the highlands of Minas Geraes and São Paulo. Of the 34,000,000 cattle in Brazil, about 25% are in Rio Grande do Sul and 22% in Minas Geraes. The sheep of Rio Grande do Sul compose about three-fourths of the total for Brazil, while swine, which are produced largely to the east in the German settlements, constitute 30% of the country's holdings.

Long the chief product, *xarque*, or jerked beef, is

being replaced by chilled or frozen beef, although there is still a great demand for dried beef in tropical Brazil and several hundred thousand cattle are annually slaughtered in over 70 plants devoted to the salting and drying of this meat. As many as ten modern slaughtering and meat-packing plants have been established in São Paulo and Rio Grande do Sul. The majority of the plants belong to the great packing companies of Chicago; others are British. Only three countries, the United States, China and Germany, raise more hogs than Brazil.

**Minerals.** Both placer and vein gold deposits are widely distributed in the highlands of the country. Nearly all the gold comes from two very deep British-owned mines near BELLO HORIZONTE, the capital of Minas Geraes. Coal is so expensive that the mining companies have installed hydroelectric plants to supply power for the mines. Diamonds have been found in Brazil for over 200 years, but the present importance of this industry is slight, due in part to the great output from South Africa. Manganese is mined in Minas Geraes, 300 mi. north of Rio de Janeiro. During the World War, when supplies from Russia and India were difficult to obtain, the output of manganese from Brazil rose to over 500,000 tons a year, valued at \$7,000,000. In post-war years, the production has been from 200,000 to 300,000 tons. Minas Geraes has iron ore deposits of fabulous richness and extent. It is estimated that there are upwards of 12,000,000,000 tons of the highest grade ore, and huge additional quantities of lower grade ore. Most of the ore lies near the surface and forms actual mountains of hematite. The most valuable deposits are about 300 mi. from the coast. No railway actually reaches them, but a line from the port of Victoria was under construction in 1931. Only small quantities of coal exist, and those are of low grade and are found in the far south; hence the high grade iron ore cannot be utilized within the country except when imported coke or coking coal is employed. Electric smelting with hydroelectric power is not practicable on a large scale. No petroleum of importance has been found.

**Transportation, Manufacturing and Trade.** Most of Brazil suffers from inadequate transportation facilities. There are about 19,500 mi. of railways, and these have touched only the fringe of eastern Brazil. In this area three different gauges exist, making practically impossible the development of a uniform system. The state of São Paulo has made distinct progress in extending a system of modern highways over its area. This state has 1,500 mi. of good motor roads, or three-fifths of the total in Brazil. Without riverways, fully half of the country could scarcely be penetrated and would remain practically unknown. The Amazon system surpasses all other river systems of the world in extent of navigable waters. RIO DE JANEIRO and SANTOS are the two leading seaports.

More than two-thirds of the manufacturing establishments are engaged in making five groups of products: food; textiles, mainly cotton, but also silk,



Ar.3,285,319 sq.m.  
Pop.....40,272,650

(Including Figures  
from Latest Popu-  
lation Estimates)

63 Alagoinhas.1 22  
108 Arassuahy

Salvador.  
100 Barbacena

109 Bello Hori-  
zonte..M 17

Grande... G 24  
148 Campinas

137 Caratinga  
M 19

84	Conquista..J	20
100	Curityba..O	13
117	Curityba..V	17

78 Feira de Sant'  
Anna....I 21

67 Grao-Mogol K 18

136 Juiz de Fora

67 Marianna.M 18

101 Passo Fundo P 11  
33 Petropolis L 15

273 Porto Alegre

1442 Rio de Janeiro N 16

126 Santos... N 15  
67 São João d'el

90 São Miguel dos  
Guanhães L18  
880 São Paulo N 15

66 Serro . . . . . L 18  
126 Theophilo-

**GUIANA**

Pop.....310,571  
PRINCIPAL.

from Latest Population Estimates)

4 Albion.....B 7  
62 Georgetown A 7

## GUIANA

Pop.....153,407

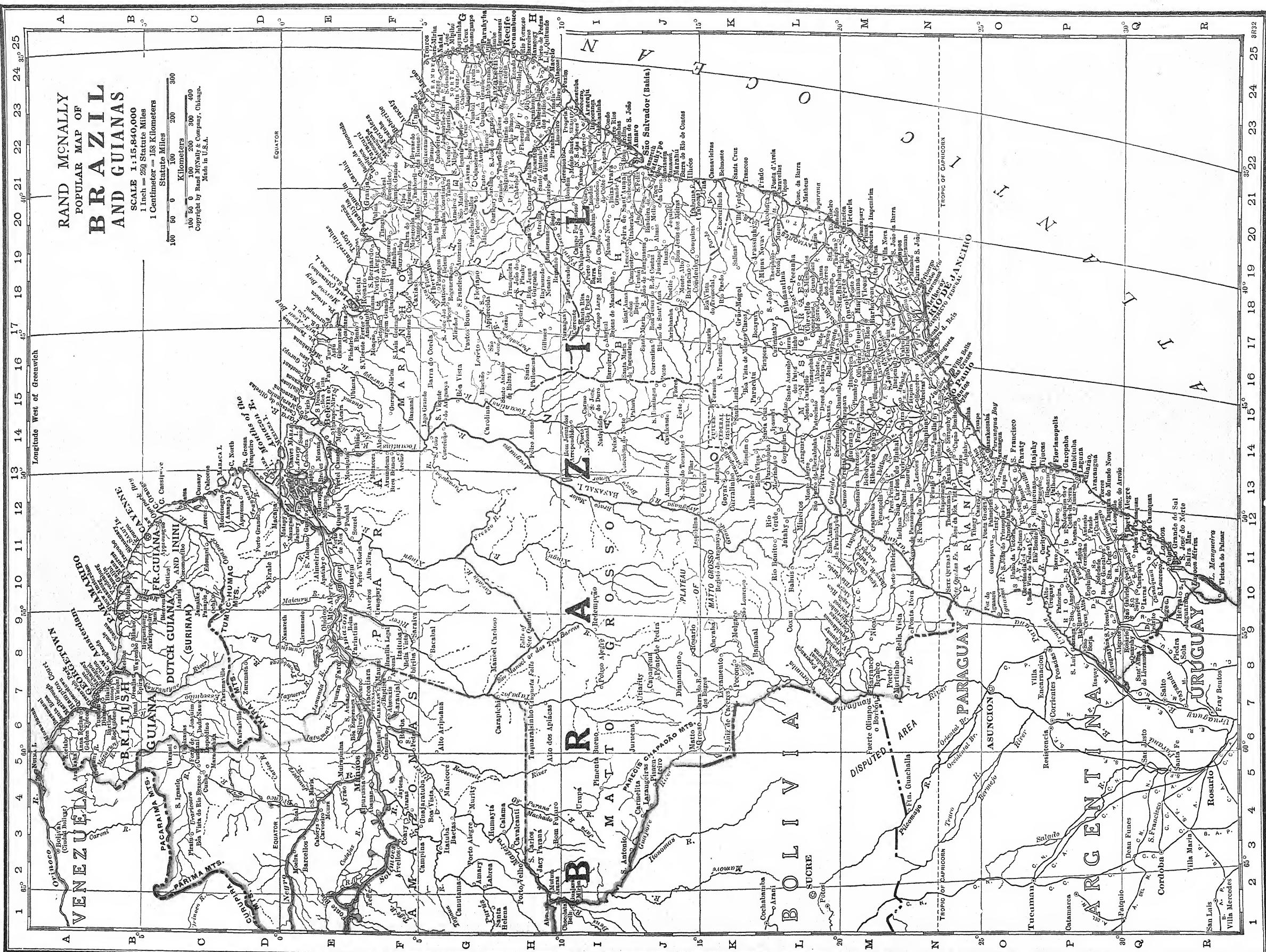
(Including Figures  
from Latest Popu-

47 Paramaribo.B 9

(French)  
Area. 51,254 sq. m.

**MINOR CITIES**  
(Including Figures)

Pop.—Thousands







wool and jute; clothing, including shoes and hats; clay products; wood products. Little progress has been made in the working of metals, and nearly all iron and steel products are imported.

Five or six agricultural products form 80% of the exports and coffee alone forms about two-thirds. Other exports are hides, cacao, *mate* and beef. The United States is the largest buyer of Brazilian products. The Americans are coffee-drinkers, as distinguished from the British, who are tea-drinkers. Sometimes Britain holds the leading place in supplying imports, sometimes the United States. The most important articles brought into the country are machinery, tools, wheat, iron, steel, automobiles, coal and gasoline.

The total international trade is relatively small, due partly to the high degree of self-sufficiency of the country. So large is Brazil that it can produce the greater part of the things that its people need. A large proportion of the population are Negroes who are content to produce little and whose wants are few and simple. The export duties collected by the individual states and the high tariff imposed by the federal government restrict interstate and international trade.

**Finance.** The milreis (= 11.96 cents) is the monetary unit. The Bank of Brazil has about 70 branches throughout the country. The actual revenue in gold and paper for 1929 had a surplus of about \$46,000,000 over expenditure. The consolidated federal foreign debt on Dec. 31, 1930 amounted to about \$690,000,000.

**Government.** Since 1889 Brazil has been a federal republic. There are 20 states, one territory (the Territory of Acre, comprising 58,672 sq. mi.) controlled by the national government and a federal district with an area of about 431 sq. mi. in which Rio de Janeiro is situated.

The country is governed under the constitution of Feb. 24, 1891, with its subsequent modifications. In general this document follows the example of the United States in the distribution of powers between the states and the nation, although there are some important differences. For instance, the states have the exclusive power to impose export taxes; they may enter into non-political agreements with each other with the approval of the national president; they may alter their boundaries with the approval of Congress, and the federal government may entrust to them the execution of federal laws.

As in the United States, the federal government may intervene in the states to repel foreign invasion or the invasion of one state by another, to reestablish order at the request of the state governments, to maintain the federal republican form of government, and to secure the execution of federal laws and judgments.

The franchise is conferred upon all male citizens 21 years of age whose names have been inscribed upon the register, but beggars, illiterates, soldiers on pay and members of certain religious orders and organi-

zations are not allowed to vote. The constitution also provides for freedom of religious worship, civil marriage, the secularization of cemeteries and public instruction, freedom of speech and the press, jury trial and the absolute separation of church and state.

The president and the members of both houses of congress are elected by direct popular vote; the president for four years without immediate reeligibility, the senators for nine years and the members of the lower house for three years. The constitution guarantees minority representation in the chamber of deputies, the number of representatives from the states and the federal district being determined on the basis of population. There are three senators from each state and three from the Federal district. In Brazilian politics there are many factions, but no parties strictly organized as in the United States and England.

**BRAZIL, HISTORY OF.** Pedro Alvarez Cabral is given the credit for the discovery of Brazil in 1500, though others had skirted the northern coast before him. In order to protect his colony from foreign interlopers, John III of Portugal sent out coast patrols in 1526. Rumors of the existence of silver in the south prompted the Crown to dispatch an expedition under a governor, Martim Affonso de Sousa, who in 1532 founded São Vicente, the first formal settlement. Soon after this the King partitioned the region, dividing it into *capitanias* or captaincies, among *donatarios* or grantees, who acted as virtually omnipotent hereditary feudal lords. Later ex-convicts were shipped to settle in the colony. The disadvantages of this decentralized system led to the appointment in 1548-49 of a governor general, Thome de Souza, who founded the city of São Salvador (Bahia). In 1555 an expedition of French Protestants under Nicolas Durand de Villegagnon established itself in the bay of Rio de Janeiro. They were ousted in 1567 by Mem de Sá, the third governor of Brazil, who founded the city of Rio de Janeiro in the same year. From 1581 to 1640, during the union of Portugal and Spain, Brazil fell prey to the enemies of Spain. English freebooters harassed the coast. The French settled in Maranhão but were forced out in 1615 and the area was separated from the rest of Brazil in 1621 and called the State of Maranhão. The Dutch attacked Bahia in 1624-25. Being repulsed there, they took Pernambuco in 1630 and until 1654 they controlled much of the territory around and to the north of that city. Count Maurice of Nassau from 1637 to 1644 was the most distinguished of the Dutch governors. In 1644 the Brazilians began a successful war against the Dutch. Peace was settled by The Hague Treaty of 1661.

**Settlement.** The internal development of the colony in the 17th century is best illustrated by the struggles of conflicting interests. In 1629 and later years slave-raiding expeditions of Paulistas destroyed in the valley of the upper Paraná the missions of the Jesuit Fathers. The Jesuits appealed to higher authorities but the decisions of these were met with derision by the Paulistas who in 1640 attempted with-

out success to set up an independent republic in São Paulo. In Maranhão, in the north, the creation of a Portuguese monopolistic trading company and the activities of the Jesuits, led by Antonio Vieira, who befriended the Indians, caused discontent among the colonists. In 1684, Manoel Bekman led a fruitless rebellion against the monopolistic company and the Jesuits. From 1644 to 1697 warfare was carried on by the authorities against the fugitive Negroes of the interior. The Palmares Republic with its "emperors" and African customs was a typical phenomenon in a frontier plantation community where Negro slaves far outnumbered the whites.

The great territorial extent of Brazil to-day is attributable to the Jesuits, who established missions in the regions around the Amazon and Paraná rivers, to the cattle raisers, who penetrated the *sertão* (the interior grasslands) of the North, and to the Paulistas, who opened up the center and West. The *senhores dos engenhos*, a plantation aristocracy of sugar mill owners, bought the Indians from the Paulistas and were the economic and cultural leaders of the colony. The Paulistas or *mamelucos* were the offspring of Indian mothers and Portuguese fathers and lived in the *capitania* of São Paulo. This new race was completely adapted to the climatic and other conditions of the New World. The Paulistas became the fiercest Indian hunters and the most persistent searchers after gold and precious stones. They spread fan-like from São Paulo in every direction in expeditions known as *bandeiras*. The period of their greatest activity was the 17th century and in the decade 1690-1700 they were rewarded by the discovery of gold.

**18th Century.** The 18th century brought a shift of interest from the north to the center and south. A gold rush to the mines took place. Planters from the coast and Portuguese from across the seas rushed into the gold area. The Paulistas, who claimed the right to the territory and wealth they had discovered, planned a war to the death, 1706-07, on the *Emboabas*, or outsiders. After much bloodshed the Paulistas were forced to give in to the Portuguese authorities who created the district called the Captaincy of Minas Geraes in 1720. In Pernambuco there took place the unsuccessful so-called nativist semi-republican revolt in the war of the *Mascates*, 1710-11. It was the result of rivalry between the debtor Brazilian planter aristocracy and the creditor wealthy merchant Portuguese class, the *Mascates*. In the same years the French occupied Rio de Janeiro and were bought off by a large sum of money only after they had plundered most of the wealth of the city. With the accession of José I (1750-77) and the Marquis of Pombal, his first Minister, liberal reforms were introduced into the life of the colony. Among other reforms, Pombal abolished the Inquisition, the temporal privileges of the clergy, and the charters of the captains-general whose captaincies had not yet been absorbed by the crown. He freed the Indians, encouraged commerce and removed the capital from Bahia to Rio de Janeiro in 1763. In 1750 and in 1777 treaties

on boundaries were signed with Spain. In 1789 a group of young poets and philosophers of Minas Geraes planned to overthrow the monarchy and establish a republic. The "Tiradentes Conspiracy," named after Joaquim José da Silva Xavier, a dentist, was betrayed, and the leaders punished.

In Nov. 1807 the Portuguese royal family and a host of noblemen and officials fled before an invading French army to Brazil, arriving in 1808. The regent D. João set up his court in Rio, opened the ports of the country, established the first press, a medical school and other institutions, abolished many of the restrictions on trade and instituted other reforms. In 1815 Brazil was elevated to the status of equality with Portugal. In 1821 D. João VI incorporated Montevideo into Brazil as the Cisplatine Province. The transference of the court to Brazil, with the vast expenditures involved and the discrimination against the Brazilian in important positions, caused a fruitless republican revolution in Pernambuco in 1817.

**Independence.** In 1821, D. João returned to Portugal because of a constitutional revolution there, leaving his son Pedro as regent. The efforts of the Portuguese Cortes to reduce Brazil to a colonial status irritated the Brazilians. José Bonifácio de Andrada e Silva dominated the situation in the years 1821-23. After a bloodless revolution independence was declared on Sept. 7, 1822 and Pedro was proclaimed Emperor of Brazil. In 1824 a constitution established a limited monarchy. The republicans of Pernambuco, not satisfied with the monarchical solution, organized the short-lived Confederation of the Equator. During the reign of Pedro I personal liberty and religious tolerance obtained, and economic progress was fostered. From 1825-28 Brazil was at war with the Uruguayans and Argentines over the possession of Uruguay, the Cisplatine Province, and the loss of the war was one of the many causes of Pedro I's decreasing popularity. The Brazilians accused him of being too Portuguese in sympathy and interest. Furthermore republican sentiment was growing. Evaristo da Veiga, brilliant Brazilian journalist, conducted the liberal *Aurora Fluminense* at this period. Pedro's troops revolted and he abdicated on Apr. 7, 1831. A regency of three at first governed the country during the minority of Pedro's son. In 1834 an amendment to the constitution, called the *Acto Adicional*, was passed. It abolished the Council of State, created provincial assemblies and a single regency. Diogo Antonio Feijo was elected regent. He soon resigned. In 1840 a law was passed declaring that Pedro II had reached his majority at the age of 15.

The first nine years of Pedro II's reign were fraught with tumults and rebellions. The Baron of Caxias, a successful general, put down, by 1849, most of the revolts. In 1845 he defeated a republican separatist movement which had been going on for 10 years in Rio Grande do Sul. In 1851-52 the Empire assisted in overthrowing the dictator Rosas in Buenos Aires and from 1865-70 joined with Uruguay and Argentina against López of Paraguay. In internal affairs Pedro

II proved to be an amiable and tolerant monarch of studious tendencies. The Amazon River was thrown open, rubber and coffee became important commodities, railroads and telegraph lines were built, and immigration was fostered. Education, museums and libraries also received his attention. In 1850 a law ended the slave trade and in 1871 the Rio Branco law freed all negro children born after that date. Finally, in May 1888, a law of Congress abolished slavery altogether. Many of the planters, disgruntled because they were not indemnified, joined the military, liberals and republicans in demanding a republic. On Nov. 15, 1889 a republic was declared and Pedro II left the country.

**The Republic.** Marshal Deodoro da Fonseca, the military leader of the revolution, became provisional President and in 1891, after the promulgation of a federal constitution, the first constitutional President. He resigned in 1891, was succeeded by Vice-President Marshal Floriano Peixoto. A naval revolt in 1893-94 was put down with much difficulty. Presidents following him were: Prudente de Moraes Barros (1894-98), a Paulista, who reduced militarism but was unable to solve the financial difficulties though he funded the foreign debt of the country; and Campos Salles (1898-1902), who, as president-elect, obtained a loan in Europe to avoid default on the public debt, which eased the financial situation. During his term and later the settlements of boundary disputes were ably negotiated by Baron Rio Branco and Joaquim Nabuco. During the term of Rodrigues Alves (1902-06) the beautification, modernization and sanitation of Rio de Janeiro took place. Dr. Oswaldo Cruz, the eminent Brazilian scientist, rid the city of yellow fever. In 1906 the hold of the Paulistas was broken by the election of Affonso Penna, three times governor of Minas Geraes, who created the conversion bureau, the *Caixa de Conversão*. He died in 1909 and was succeeded by Nilo Peçanha. Marshal Hermes da Fonseca won the election against Ruy Barbosa and served from 1910-14. A naval meeting, which led to much needed reforms in naval administration, and a financial crisis, resulting from the fall in coffee and rubber prices, embarrassed the Government. Wenceslau Braz served from 1914-18. In 1917 Brazil declared war on Germany. Steps toward economic independence and economic progress were results of the war. In 1919 Epitacio Pessoa, of the state of Parahyba, representing Brazil at the Paris Peace Conference, was elected to fill out the term of Rodriguez Alves who died soon after his reelection in 1918. Pessoa ill-advisedly began irrigation projects against the drought in the northern states. Arturo Bernardes of Minas Geraes, elected in 1922, had to cope with a military revolution in 1924 and an economic depression. A British commission made recommendations and the economic situation improved. In 1926 Washington Luiz of São Paulo was elected to serve until 1930. He is known as "the road builder." In 1930 Julio Prestes of São Paulo was elected to succeed him. A revolution in the same year, led by Getulio Vargas, President of Rio Grande

do Sul, against control by the coffee states overthrew Luiz and prevented the accession of Prestes. Vargas then governed as provisional President. P. V. S.

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**BRAZIL**, a city in western Indiana, the county seat of Clay Co., 16 mi. northeast of Terre Haute. It is served by three railroads. There are clay and shale deposits and coal fields in the region. The city has many industries including the manufacture of sewer pipes, tiles, bricks, floor dressings and mining machinery. Pop. 1920, 9,293; 1930, 8,744.

**BRAZILIAN LITERATURE**, the literature, in the Portuguese language, of Brazil, South America, which is treated under **LATIN-AMERICAN LITERATURE**.

**BRAZIL NUT** (*Bertholettia excelsa*), a handsome South American tree of the lecythis family, growing in the forests of the Amazon and Orinoco valleys. It attains a height of 150 ft. and bears large leathery leaves about 2 ft. long. The fruit is a round hard-shelled nut, sometimes 6 in. in diameter, enclosing about 20 closely packed seeds. These seeds, somewhat triangular in shape with a thin hard covering, are the brazil nuts of commerce.

**BRAZIL WOOD**, a valuable dyewood obtained from several trees of the pea family chiefly of the genus *Casalpinia*, growing in South America and in the West Indies. The heavy wood, bright reddish-brown when freshly cut but turning dark upon exposure to the air, yields the soluble red coloring matter known as brazilin. The dyestuff is made into red ink, chemical indicators, and lakes for decorative purposes.

**BRAZING AND SOLDERING**, methods by which metals are joined by using other metals with a lower melting point to complete the joint. Metal used in brazing has a higher melting point than the usual soft solder. Brazing is frequently called "hard" soldering. The main precaution in either case is thoroughly to clean the surfaces to be joined and to fit them together as well as possible. Fluxes are used to prevent the formation of oxides when the parts are heated and to assist in the flow of the solder as it melts. A saturated solution of zinc dissolved in muriatic acid is a common type of flux, but commercial soldering pastes are usually more convenient. Special fluxes are prepared for various metals when work is done in large quantities. Resin, beeswax and tallow are sometimes used.

Soldering is done either with a soldering iron which melts the solder into the joint or with a blow pipe or

torch. Electric soldering irons are now commonly used, as they can be kept at a constant temperature without reheating, thus permitting continuous work. Brazing is done either with a blow pipe or gas torch of some kind, or by the dipping process. As the metal to be joined must be raised to a higher temperature than for soldering, a soldering iron cannot be used. In dip brazing the work to be brazed is dipped in molten brazing metal until it is heated sufficiently for the brazing material to flow into the joint. Soldering can also be done by the dipping method. F. H. C.

**BRAZOS RIVER**, a large river in Texas having its origin at the juncture of the Salt and Clear Forks in the west central part of the state called the Staked Plain. The general direction of its course is southeast through a fertile agricultural region and alluvial deposits near its mouth. It empties into the Gulf of Mexico in Brazoria Co. about 40 mi. southwest of Galveston. The Brazos has a very moderate fall of 400 ft. throughout its length of almost 950 mi. The river is navigable by steamboats in times of high water as far as Waco, but at other times only to Columbia.

**BREAD** is essentially an energy food. Although the average baker's loaf contains all five fundamental nutritive constituents:—CARBOHYDRATES, FAT, PROTEIN, minerals, and some vitamin (*see* VITAMINS IN FOOD) it is principally composed of carbohydrate material. The moisture content, when compared to the high water percentages of nearly all other FOOD STUFFS is such as to make bread a highly concentrated article of diet. The average loaf is composed of approximately 52% carbohydrates, 9% protein, 2% minerals, 2% fat, and 35% moisture. Such a loaf yields 1209 calories per pound, but does not supply these energy units in the proper proportion to make bread by itself a completely balanced food. The vitamin content is negligible, or at least limited, depending on what percentage of MILK the baker uses.

Bread may be well described as our principal complementary food. Because of its neutral taste and flavor it "goes well" in nearly all food combinations. It is perhaps the only manufactured food which may be pleasurably eaten with the natural foodstuffs, including most vegetables, fruits, and meats. The milk-bread-and-butter combinations, when supplemented by fruits and meats, provide a highly nutritious diet. The mineral and vitamin content of the green vegetables is well balanced by the high energy value of the bread. Buttered bread with milk and fruit provides a complete diet from the nutritional standpoint. With those foods high in protein, such as meats and the various kinds of CHEESE, bread is also the principal complementary food. Because of this unusual ability to enter into highly nutritious combinations, bread has won a permanent place in the human diet the world over. The nutritive value of bread eaten by itself depends upon the ingredients incorporated in the dough. In large scale production the percentages of flour, yeast, salt, sugar and shorten-

ing have become fixed between quite definite limits, but the amount of milk used may vary from none at all to a complete replacement of water by whole milk, or its equivalent in milk solids, and as a rule the nutritive value of bread varies directly with the percentage of milk or milk solids used. There is also considerable variation in the milk content of the various types of bread. The hearth breads, such as rye and Vienna, usually contain but little if any milk solids, and as a class are therefore less nutritious than the usual white loaf. Whole wheat and graham breads, provided they contain like proportions of milk solids, are approximately equal nutritionally to bread made with white flour.

A few bakers produce "milk bread," which according to government standards is defined as bread in which not less than one-third of the water ingredient has been replaced by milk or the constituents of milk solids in the proportions normal for whole milk. Such bread as this possesses a slightly higher nutritive value than the usual commercial loaf. Full milk bread, containing three times the proportion of milk used in "milk bread," is an exceptionally nutritious article.

A "super loaf," designed to adequately supply all human dietary needs was at one time produced in the United States by a large wholesale baking chain. Although carefully planned feeding tests demonstrated that the essential dietary needs were fulfilled this superbread seemed to lack the palatability necessary to make it commercially successful. Bread, whether whole wheat, graham, rye, or the usual white loaf still remains an outstanding energy food, and while deficient in certain essential protein, mineral, and vitamin constituents, it is very nutritious as attested by its large universal consumption. *See also* FOOD; FLOUR. H. E. BA.

**BREADALBANE**, a district of Perthshire, Scotland, lying northwest of Edinburgh, and covering about 1,020 sq. mi. The region is bounded by the districts of Strathearn, Atholl, Strathay, Argyll and Lorne. The principal peak is Ben Lawers. The land of the valleys and glens is not particularly fertile, but game, including deer, is plentiful, and with the well-stocked lakes and rivers, makes Breadalbane a sporting center. There are six rivers, including the Upper Tay, flowing into beautiful Loch Tay. Population concentrates in Aberfeldy, Killin, Kenmore and Fortingal.

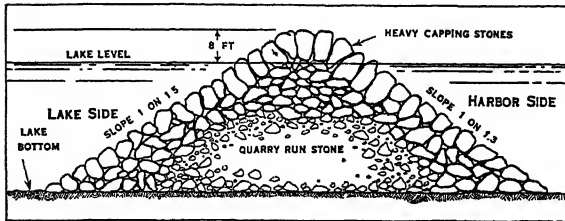
**BREADFRUIT** (*Artocarpus communis*), a broad-topped tree of the mulberry family, native to Polynesia and grown widely in tropical countries for its edible fruit. The tree attains a height of about 50 ft., bearing thick, leathery, deeply lobed leaves, about 2 ft. long, and great clusters of yellow flowers. The large globular fruit is an indispensable food to the inhabitants of many oceanic islands. It is usually cooked as a vegetable, the baked breadfruit somewhat resembling wheat bread. A flour made from the dried slices is also widely used. The fibrous inner bark of the young trees is woven into a cloth by



the natives, who use its wood for canoes and furniture. Glue and caulking material are derived from the viscid milky juice. The Jack fruit (*A. integrifolia*), valuable for its lumber, produces a similar but inferior fruit, much eaten in India.

**BREAKTHROUGH.** See CROSSCUT.

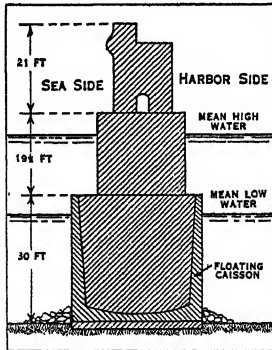
**BREAKWATERS**, structures breaking the force of waves, and partially or entirely enclosing a water area, forming an ANCHORAGE, mooring or "berth" for vessels. Such a structure, projecting into an inlet or



CROSS SECTION OF RUBBLE MOUND BREAKWATER AT CLEVELAND

river mouth, is generally referred to as a JETTY. A breakwater, the lee side of which is used for wharfage, is known as a "mole."

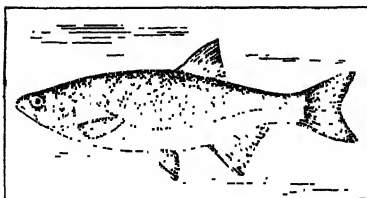
Breakwaters are laid out in many forms, and the construction is of various types, the most common being "rubble mound," which consists of large stones placed in the zone of strongest wave action, with a "core" of smaller, lower-grade material. In some cases the top stones are laid regularly to form a "smooth" rubble mound. The advantages of "rubble mound" are simplicity, economy in many cases, and the fact that large plane surfaces are not presented to the blow of the wave—the rough slope more gradually absorbing



MASONRY BREAKWATER CROSS SECTION, ZEEBRUGGE, BELGIUM

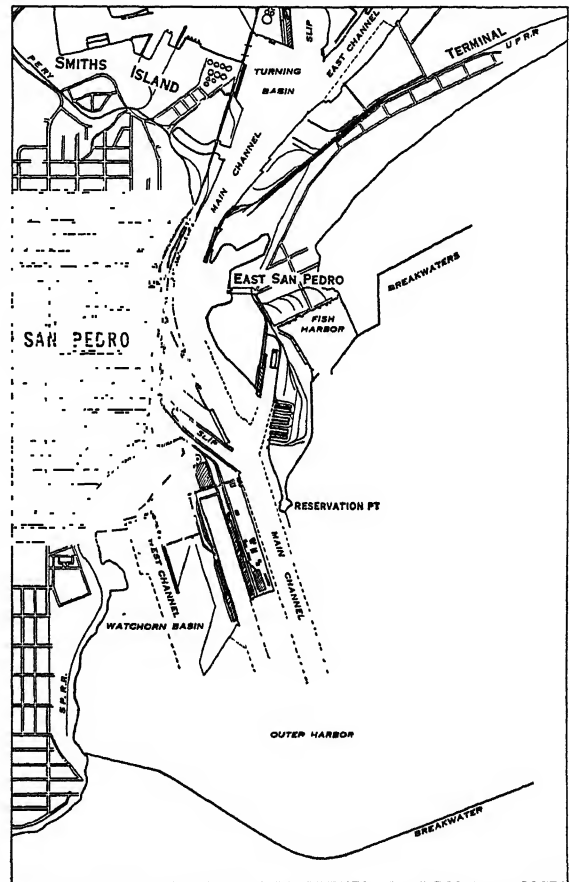
"wave impact." Other types are cut stone or concrete block, stone or concrete, timber crib, floating CAISSON (generally of reinforced concrete) and various combinations of these. See COAST PROTECTION; HARBORS. F. R. H.

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AMERICAN BREAM OR GOLDEN SHINER

**BREAM**, a name applied to various fresh-water fishes of the CARP family (*Cyprinidae*), especially to the carp bream (*Abramis brama*) and the white bream (*A. blicca*) of northern Europe. Both are of medium size and occur in quiet waters; the former, which was a favorite with Izaak Walton, attains a weight of from 6 to 12 lbs. The American bream (*Notemigonus crysoleucas*), called also golden shiner, is about a foot long, greenish above and silvery with brilliant yellow reflections on the sides. It is common in weedy ponds and streams from Nova Scotia to North Dakota and southward. Various other American fishes, especially several sunfishes, are also called bream. See also SUNFISH.



BREAKWATER OF LOS ANGELES HARBOR, CALIFORNIA

**BREAST**, in mining, a term generally used to designate the end, or face of a STOPE or DRIFT, in an ore deposit, especially where the ore is being mined. In coal mining, breast refers to the Room in which the coal is mined. See also MINING, COAL; MINING, METAL.

**BREAST**, a paired gland, the mamma or mammary gland, situated over the front upper part of the thorax, whose function, in the female, is the secretion of milk. The gland, on each side, is composed of 15 or 20 minute lobules. A lobule consists of an elaborately branched duct, of which each terminal ramification ends in a cluster of milk-secreting cells.

Before opening at the nipple, each duct enlarges into an ampulla. The nipple is surrounded by a pigmented areola, pink in women who have not born children and dark in those who have. Numerous small glands which, during lactation, secrete a protective wax, open on the areola. Under the influence of pregnancy the gland enlarges and secretes milk for the nourishment of the infant.

The breast may be the seat of inflammation, abscess, cyst, or tumor, especially cancer. Mastitis, or inflammation of the breast, during lactation, follows infection through a cracked nipple during suckling. When severe, the infection may result in abscess. In such a case, the infant should be weaned, and the breast be put at rest and the pus drained. Cysts result either from retention of milk in a clogged duct, from a chronic infection, or as a new growth. They are treated by incision or are excised. Tumors of the breast are apt to be very dangerous because of their likelihood to prove cancerous. A physician should immediately be consulted upon the discovery of any suspicious lump of the breast. See **CANCER**.

W. J. S. K.

**BREASTED, JAMES HENRY** (1865- ), American Orientalist and historian, was born at Rockford, Ill., Aug. 27, 1865. Graduating in 1888 at North-Central College, he continued his education at Chicago Theological Seminary, Yale, and in Berlin. In 1894 he became assistant in Egyptology at the University of Chicago, and professor of Egyptology and Oriental history in 1905. At the same institution he was appointed director of the Haskell Oriental Museum, 1901, and director of the Oriental Institute when it was founded in 1919. He has conducted several important archaeological explorations in Egypt, Palestine, Syria and other parts of the Near East on behalf of the University of Chicago. As leader of an expedition to Nubia and the Sudan, 1904-06, he compiled a record of all the temple and tomb inscriptions then known between the First and Fourth Cataracts of the Nile, which he translated and included in his *Ancient Records of Egypt* (5 vols., 1906-07). In 1906 appeared his *History of Egypt*, a fascinating and clearly written work reconstructing the ancient Egyptian civilization. Its publication had the effect of creating a widespread interest in the subject. Breasted's other works include *A Survey of the Ancient World* (1919), *Development of Religion and Thought in Ancient Egypt* (1912), *History of Europe, Ancient and Medieval* (with J. H. Robinson, 1920), and *The Conquest of Civilization* (1926). He was president of the American Oriental Society in 1919, and president of the American Historical Association, 1927-28. In 1931 he completed and he was director of a new Oriental Museum at the University of Chicago.

**BRÉBEUF, ST. JEAN de** (1593-1649), French pioneer missionary, was born at Condé-sur-Vire, Normandy, Mar. 25, 1593. In 1617 he entered the Society of Jesus, and went to Quebec in 1625 to start his missionary work among the Indians. The next year he established a mission at Ihonatiria on Lake Huron,

but, in 1628, was compelled to abandon it because of the hostility of the Indians there. During the succeeding years, although hampered by stern privations and suffering, he persevered in his work of converting and educating the savages until captured in Huron country, and killed at St. Ignace, Quebec, Mar. 16, 1649. He was canonized June 29, 1930.

**BRECCIA**, a rock composed of angular fragments which have been cemented into a compact mass. **FAULT** or friction breccias consist of the fragments broken from the fault walls during movement along the fault plane. Eruptive breccias may be composed of pieces of surrounding rocks gathered up by still molten intrusions; or of cooled portions of intrusions or **LAVA** flows, engulfed in the still liquid lava which solidified later; or of fragments ejected during a volcanic eruption and later consolidated. Talus breccias consist of the recemented, angular débris which accumulates at the base of cliffs. See also **TUFF**; **VOLCANIC ASH**.

**BRECHIN**, a royal burgh of Forfarshire, Scotland, on the South Esk, about 60 mi. directly northeast of Edinburgh. Occupying the site of a 10th century abbey, it was burned by Danes in 1012, rebuilt, and created a bishopric in the middle of the 12th century, which it still remains. Brechin has a pointed medieval cathedral, a curious "Round Tower" dating from about 1000, the castle, and a charitable fund granted by James VI. Little else remains of its antiquity, and to-day Brechin is industrialized, manufacturing rope, linen, paper, flax and distilled products. Pop. 1921, 7,446; 1931, 6,838.

**BRECKENRIDGE**. A city in north central Texas, the county seat of Stephens Co., situated 110 mi. west of Fort Worth, and served by two railroads. Cotton, grain and live stock are raised in this region. The oil-fields discovered in 1918 are extensive and valuable. The city has oil refineries and a carbon black factory. Breckenridge was founded in 1876; incorporated in 1919. Pop. 1920, 1,846; 1930, 7,569.

**BRECKINRIDGE, JOHN CABELL** (1821-75), 14th Vice-President of the United States, was born near Lexington, Ky., Jan. 21, 1821. He graduated from Centre College in 1839 and attended Transylvania College for the study of law during the year 1840-41. From then until 1847 he practised law in Frankfort and Burlington, Iowa, and finally in his native town of Lexington. The war with Mexico which began in 1846 did not move him to abandon civilian life until the summer of 1847 when he was commissioned a major of the Kentucky volunteers, but he led his regiment into Mexico only after hostilities had ceased. Breckinridge was a Democratic member of Congress 1851-55, and in 1856 was elected Vice-President of the United States. In 1860, as the presidential candidate of the southern branch of the divided Democratic Party he received 72 electoral votes. In 1859 he had been elected a member of the United States Senate from Kentucky. He attended the special session of the Senate beginning July 4, 1861, but after the fall of Ft. Sumter, he contended

that the Union was dissolved and that Kentucky could follow any course she chose. He was active in promoting Confederate sentiment in Kentucky, and in November he was commissioned a brigadier-general of the Confederate troops. The Senate then declared him a traitor and expelled him. In 1865 Jefferson Davis appointed him Secretary of War of the Confederate States. After the war he fled to Europe. In 1869, he was permitted to return to Kentucky where, acclaimed as a popular hero, he resumed the practice of law. He died at Lexington, May 17, 1875.

**BRECKNOCK.** See BRECON.

**BRECON**, or **BRECKNOCK**, cathedral town and capital of Breconshire, south Wales, situated at the junction of the Usk and Honddhu rivers, 183 mi. northwest of London. An early settlement near the Roman *Y Gaer*, it developed about the Norman castle and Benedictine Priory, both of which survive in part. The Priory church, however, is now the cathedral of the Swansea-Brecon diocese, and, although the earliest portions have disappeared, it is a magnificent example of medieval Welsh ecclesiastical architecture. Modern Brecon is a market town and fishing center. Pop. 1921, 5,646; 1931, 5,334.

**BREDA**, a city and former fortress in the Dutch province of North Brabant, at the confluence of the Merk and Aa. It has seven churches, among them the Reformed Gothic cathedral, and an old castle completed in 1696, now a military academy. The chief industries are the manufacture of cloth and carpets. There are iron foundries and cigar factories. In 1581 the city was captured by the Spaniards and in 1590 it became the capital of a dominion which came to the House of Nassau by marriage. Breda was forced in 1625 to surrender again to the Spaniards. The treaty of peace between England and Holland, providing that New York was to remain English, was signed there in 1667. Pop. 1930, 44,860.

**BREECH MECHANISMS.** There are two essentially different types of breech mechanisms; the interrupted screw type for the larger guns using powder charges in bags and the sliding-wedge type for smaller guns which have their powder charges in metallic cartridge cases. In the former, the cylindrical breech-plug locks into teeth in the breech when rotated a fraction of a turn and obtains obturation by a plastic gas-check pad. In the sliding wedge mechanism, the breech block moves across behind the base of the cartridge case, and the sealing action of the cartridge case prevents gas leakage. Semi-automatic breech mechanisms close automatically when the cartridge case is inserted, and on firing, operate to eject the empty case. In certain guns a rammer is built into the breech housing so that when the cartridge is placed ahead of this rammer it is rapidly pushed by power into the chamber even though the gun is at extreme angles of elevation. See also ARTILLERY.

**BREEZE**, a motion in the earth's atmosphere not strong enough to be termed a wind, often variable or intermittent in strength, and never exceeding 10-12

miles per hour in speed. The term is most frequently qualified, as sea breeze or land breeze, meaning light and steady winds, the former blowing from the sea during the day, the latter toward the sea at night.

**BREHON LAWS**, a system of laws prevailing in Ireland farther back than the 5th century and lasting until the middle of the 17th century. The laws were expounded by hereditary judges who held court in the open air. The manuscripts containing these laws vary in date from the 14th to the 16th centuries, and are written in Middle Irish.

**BREITENFELD, BATTLE OF**, Sept. 17, 1631, the conflict during the THIRTY YEARS' WAR between the Allied Swedish and Saxon forces led by Gustavus Adolphus and the imperial army led by Count Tilly. The opposing forces met outside the village of Breitenfeld, five miles northwest of Leipzig. The imperial forces, numbering 35,000, were badly defeated, with the loss of 12,000 men.

**BREMEN**, the smallest German state. It has an area of 99 sq. mi. Most of its territory lies along the lower Weser River and contains the city of BREMEN; other detached smaller parcels of land further downstream are the towns of Vegesack and BREMERHAVEN. The country is low and marshy and the climate mild. Of the 167,581 persons gainfully employed in 1925, 68,446 were engaged in industry and trades, 64,232 in commerce and transportation and 5,289 in agriculture. Vegetables and grain, and especially hay, are grown on the productive land and cattle are raised. Bremen and its seaport, Bremerhaven, are the centers of great shipping enterprises and have important allied industries.

The constitution calls for a house of burgesses elected on a democratic basis, which in turn elects a senate of 12 members. The two houses govern the city of Bremen as a municipality, as well as the state.

Of the 338,846 inhabitants in 1925, 95.2% are concentrated in the three cities and 4.8% in the country. Of the population 292,126 are Protestants; 21,871, Catholics, and 1,508, Jews.

**BREMEN**, the capital and seaport of the state of BREMEN. It is on the Weser River, 75 mi. from its mouth on the North Sea. The old city, surrounded by parks in place of the former walls, attained those boundaries in the 13th century. Dating from the days of the Hanseatic League, it is on the right bank of the river; the new town, connected to it by four bridges, on the left. Important buildings are the Gothic rathaus, or town hall, the St. Peter's Cathedral, now a Lutheran church, and the Church of St. Ansarius, dating from the 13th century and surmounted by a spire 300 ft. high. After Hamburg, Bremen is the largest international port of Germany. The total water surface of the port in 1927 was 126 acres; ships of a 25-ft. draft are able to enter the port. In 1929, 5,044 vessels entered the port carrying a net tonnage of 6,060,305. Shipbuilding, jute-spinning, rope-making, the milling of grains and refining of oils are among the chief industries of the city. Pop. 1925, 294,966.

**BREMER, FREDERIKA** (1801-65), Swedish novelist, was born at Tuorla, Finland, Aug. 17, 1801. She wrote many novels, including *Sketches of Everyday Life*, *The H. Family*, *The President's Daughters*, *The Neighbors*, *Axel and Anna*, *The Home*, *Nina* and *Hertha*. Her travels were extensive, and she once spent two years in the United States, where she met Longfellow, Emerson, Henry Ward Beecher and other celebrities. She was deeply interested in religion and sought as her ideal church one where Fénelon and Channing, Hildebrand and Luther, Washington and Vinet, Birgitta and Florence Nightingale might join in hymns of praise, and from which neither Lao-tse, Zoroaster, Buddha, Socrates nor Spinoza would be barred. She died at Arsta, Dec. 31, 1865.

**BREMERHAVEN**, a seaport belonging to the state of BREMEN, located at the confluence of the Geeste and the Weser rivers. Among the educational institutions are schools for marine engineers and mechanics. Shipbuilding and the manufacture of ships' accessories are the chief industries. There are six harbors with large docks of the North German Lloyd line, cotton warehouses and tanks. In 1929, 1,184 vessels entered the port carrying an aggregate tonnage of 2,781,920. Larger vessels unable to dock at Bremen partially or wholly unload here. Fishing is also an important activity. Pop. 1930, 24,900.

**BREMERTON**, a city in Kitsap Co., western Washington, situated on an arm of Puget Sound, 15 mi. southwest of Seattle, on Navy Yard Highway. Air and water ferries afford transportation. Bremerton is the largest city in the United States having no railroad connections. It is the seat of the Navy Yard, Puget Sound, formally established under that title in 1901. The Navy Yard affords occupation to 3,500 civilians and is the home base of two-thirds of the United States battleships. There are shipbuilding yards. In 1929 the retail trade amounted to \$7,323,945. Bremerton grew up around the Navy Yard and was incorporated in 1901. It is the gateway to the Olympia Peninsula, noted for its scenery and wild animal life. Charleston was consolidated with Bremerton in 1928. Pop. 1920, 8,918; combined with Charleston, 12,256; 1930, 10,170.

**BRENHAM**, a city in southeastern Texas, the county seat of Washington Co. It is situated 80 mi. east of Austin and is served by the Houston and Texas Central and Gulf Colorado and Santa Fé railroads. Brenham is a shipping center for cotton, grain, and live stock; it manufactures cotton and cottonseed oil products, and farming implements. The city has besides machine shops, foundries and a large chick hatchery. Brenham was founded in 1844 and became a city in 1873. Pop. 1920, 5,066; 1930, 5,974.

**BRENT, CHARLES HENRY** (1862-1929), American clergyman, was born at Newcastle, Ont., Apr. 9, 1862. He was graduated from Trinity College, Toronto, 1884, and from the Divinity School there, 1901; was ordained deacon of the Protestant Episcopal Church, 1886, and priest, 1887. He held ministries in Buffalo and Boston with outstanding

success, and in 1901 he rose to be bishop of the Philippine Islands, where he became active in the investigation of the opium menace. He became bishop of western New York in 1918, and was chief of the chaplain service of the American Expeditionary Forces. Bishop Brent was United States representative on the advisory committee on narcotics of the League of Nations, and the Assembly of the League, 1923. He was president of the World Conference on Faith and Order, 1927. He died in Lausanne, Switzerland, Mar. 27, 1929.

**BRENTANO, LUDWIG JOSEPH (LUJO)** (1844- ), German economist, was born at Aschaffenburg, Bavaria, Dec. 18, 1844. In 1868 with the statistician Ernst Engel he made a survey of English trade-unions which he published in his *Die Arbeitergilden der Gegenwart*. He was successively professor of political economy at the universities of Breslau, Strassburg, Vienna, Leipzig and Munich. He was a leading pacifist in Germany and in 1927 received the Nobel Peace Prize.

**BRENTFORD**, an urban district of Middlesex, England, at the junction of the Thames and the Brent which, in turn, is joined by the Grand Junction Canal, about 10 mi. west of London. In 1016 the Danes suffered one of their rare defeats near the town. During the 16th and 17th centuries Brentford was a popular London resort to which Elizabethan dramatists, Shakespeare included, frequently referred. Splendid Sion House, situated on an old convent site, was erected by Lord Protector Somerset in the middle of the 16th century and later restored by Inigo Jones and Robert Adam. There is a famous carillon in the ancient tower of St. Lawrence's Church. The modern town has soap-factories, sawmills and breweries, and also cultivates market gardening. Pop. Brentford and CHISWICK, 1921, 57,970; 1931, 62,617.

**BRESCIA**, a city of northern Italy, capital of the province of the same name and the second city in Lombardy. It is finely situated in the Po Valley. The old city, surrounded by promenades in place of the former walls, lies at the foot of a crag surmounted by a citadel. The suburbs extend into the plain and creep up the hills with their villas, parks and vineyards. The city has railroad connections with Milan and Venice. Its former importance and present intellectual and cultural life are attested by its splendid architecture—both ancient and modern. The most famous of the churches are the old and new cathedrals, Santa Maria dei Miracoli, S. Afra, and S. Clementi. Other noteworthy buildings are the medieval Loggia and Broletto now converted into municipal buildings, the Monte di Pietà, a former temple of Vespasian containing treasures of Roman antiquity, the Museum of Medieval Christian Art and the picture gallery of Tosio-Martinengo. The Biblioteca Quiriniana also contains a fine art collection. As the ancient *Brixia*, Brescia was the flourishing center of a Lombard duchy. From 774 it was the seat of Frankish counts, later it was subject to the bishops, and in the 11th century was one of the most important of

the free cities of Lombardy. In the 12th and 13th centuries it sided with the Guelphs. After 1258 it frequently changed its overlords, who fought for the city until it fell to Venice in 1428. After the French occupation, 1797, it belonged to the Cis-Alpine Republic, then to the Napoleonic kingdom of Italy and in 1815 to Austria. Brescia has belonged to United Italy since 1860. There is considerable trade in the products of the fertile countryside and flourishing textile and metal industries. Pop. 1931, 118,839.

**BRESLAU**, seventh city in Germany and third in Prussia, capital of the province of Silesia. It is situated on the Oder River, lying on both sides on the rich, level plain. Located at a point where the river has many arms and islands, it was predestined to be a city of fortified bridges and the meeting place of trade routes from Germany, Poland and Bohemia. The old city, with its market place, was surrounded by a moat which has been filled, and is, in part, most picturesque. New modern sections with parks and promenades have grown up on all sides. The most noteworthy buildings are the late-Gothic Rathaus, the St. John's Cathedral, begun in the 12th century, and the Baroque St. Matthew's. The many handsome patrician houses recall the glory of medieval times. Breslau has a large Baroque university, established by the Jesuits. Pop. 1925, 557,139.

**BREST**, a city and the foremost naval station in France, situated on a sheltered bay at the point of Finistère in Brittany, 154 mi. northwest of Rennes. The city is built on two hills, divided by the Penfeld River into Brest proper on the left bank and Recouvrance on the right. Always a strategic point, Brest was held by the English from 1342 to 1397. Richelieu began the construction of the naval station in 1631, Colbert made improvements, and Vauban erected new fortifications in 1680-88; since then the station has been steadily developed. During the World War it was the chief port of debarkation for the American Expeditionary Force. It has a commercial harbor, but its industries are in the main bound up with its naval importance. There are cable connections with the United States and French Africa. Pop. 1931, 69,841.

**BREST-LITOVSK**, a city of Poland, capital of the voievodship of Polesie, 160 mi. east of Warsaw. Brest Litovsk was made famous by the treaties between Bolshevik Russia and the Central Powers in Mar., 1918. It is an important junction station for railways to Warsaw, Kiev, Moscow and East Prussia. The city belonged to Russia from 1795 until the end of the World War when it reverted to independent Poland. The official name of the city is Brzesc nad Bugiem. Pop. 1930, 45,000.

**BREST-LITOVSK, TREATY OF**, Mar. 3, 1918, a treaty between Russia and the Central Powers. After the overthrow of the Kerensky régime in Russia, in Nov. 1917, the Bolsheviks demanded a clear statement of war aims from the Allies, at the same time announcing their own policy for peace without conquest or reparations. While the Allies, who had been

joined by the United States in Apr. 1917, refused to commit themselves, Germany seeing the great strategic advantage of peace on the east front, offered to make terms. Negotiations at first proved extremely difficult and were several times broken off. In the end, however, the Germans ordered an advance toward Petrograd and issued an ultimatum. Under this threat the Soviet commissioners, eager to devote their energies to organizing and consolidating their position at home, agreed to reopen the negotiations and early in March agreed to the treaty, the terms of which provided for (1) the surrender of Courland, Lithuania and Poland; (2) the evacuation by Russian forces of Livonia, Esthonia, Finland and the Aaland Islands; (3) the evacuation of Ukraine and the recognition of the treaty between the Republic of the Ukraine and the Central Powers; (4) the surrender of Russian Trans-Caucasus to Turkey, and (5) the cessation of all Bolshevik propaganda in the Central Powers. Supplementary treaties in August obligated Russia (1) to pay 6,000,000,000 gold marks in payment for losses caused to Germany by Russia; (2) to grant Germany the most favored nation treatment, and (3) to permit the free export of timber.

In Russia the peace, even with its unheard of cost, passed without serious notice. The nation was too deeply engrossed with its domestic problems. To the Central Powers, especially Germany, it afforded the unexpected opportunity of withdrawing all their armies engaged in the offensive on the east front and transferring them for the great and final effort at victory in the west.

**BRETHREN OF THE COMMON LIFE**, a confraternity of secular priests and laymen which flourished in the Netherlands and Germany from about 1380 to the time of the Reformation. Organized by a zealous Dutch priest, Geert (Gerhard) de Groot, the brotherhood imposed no vows but enjoined the cultivation of inward holiness. Its members supported themselves by educational and literary work; their schools at Derventer and Windesheim were centers of learning in the 15th and early 16th centuries, counting among their illustrious pupils Erasmus, Thomas à Kempis, Nicholas of Cusa and Pope Adrian IV.

**BRETIGNY, TREATY OF**, May 8, 1360. Unable, despite his victories and the capture of King John, to gain a military decision, Edward III at Bretigny agreed to preliminary terms of peace. France ceded Guienne, Poitou, Saintonge, Agenais, Perigord, Limousin, Quercy, Bigorre, Gaure, Angoumois, and Rouergue in the southwest, and Montreuil, Ponthieu, and Calais in the north. Edward renounced his pretensions to the French crown, and his claims to Normandy, Anjou, Maine, Brittany and Flanders. John's ransom was fixed at 3,000,000 gold crowns. A definitive treaty of peace on this basis was concluded at Calais in October. This marks the end of the first period of the HUNDRED YEARS WAR. The terms were impossible and were never completely executed.



**BRETON, JULES ADOLPHE** (1827-1906), French painter of peasant life, was born at Courrières, France, May 1, 1827. He began the study of art at 16, and after lessons in Ghent, Antwerp and Paris was launched on his career. Historical painting first occupied him, but he soon found his true vein in representing peasant life, one of his earliest successes being *The Return of the Gleaners*, now in the Luxembourg. His paintings lack the simplicity and realism of Millet but they are pleasing in color and composition. The well-known *Song of the Lark* is in the Art Institute, Chicago, and the Metropolitan has his *Religious Procession in Brittany*. *The First Communion* is another picturesque bit of Breton life. Author as well as painter, Breton described his own life in *La vie d'un artiste* and *Un peintre paysan*. The artist died in Paris, July 4, 1906.

**BRETON**, a language of the Brythonic branch of the CELTIC group of the INDO-EUROPEAN linguistic family spoken by some 1,300,000 persons in Brittany west of a line drawn from Plouha to the mouth of the Vilaine, though in the 9th century it ran, roughly, from Dol to Donges. It is not descended from GAULISH, but was brought to its present area by immigrants from Britain from the 5th century A.D. onward so that it has a very close affinity with WELSH and CORNISH. There are now four distinct dialects (scarcely recorded before the 16th century): Tréguerois (northern Finistère), Léonnais (from Morlaix to Plouha), Cornouaillais (southern Finistère), and Vannetais (Morbihan), the latter marked off from the rest especially by accenting the last syllable rather than the penult. Efforts are now being made to establish a general literary Breton for the entire region. The language falls into three periods: Old (7th to 11th century), Middle (11th to 17th), and Modern (from the 17th). Its grammatical structure is essentially that of the other two Brythonic dialects, but it agrees with Cornish against Welsh in its system of enumeration and in possessing the verb-type "I who speak"—"I speak."

L. H. G.

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**BRETON LITERATURE**, the literature of the ancient province and duchy of Brittany or Brittany, France, which is discussed in the article on CELTIC LITERATURE.

**BREVE**, a musical note having twice the value of a semi-breve or whole note. It formerly was written  $\text{≡}$  but now is generally written  $\text{≡}$  and is almost exclusively found in ecclesiastical music. The fact that breve, or brevis, is the name of the longest, rather than the shortest or briefest, note in current usage is explained by the fact that the breve was originally named to distinguish it from a note twice as long, namely, the *longa*. See NOTATION.

**BREVIARY** (Latin *breuiarium*), the official book of devotion of the Roman Catholic clergy at the prescribed CANONICAL HOURS. The collection of prayers and formulas prescribed by Gregory VII in 1074

was repeatedly revised through the centuries by later popes. It consists of a large number of prayers, hymns, antiphons, responses, passages from the Bible and patristic writers and from histories of the saints. The breviary is divided into four parts, corresponding to the four seasons of the year, and into four chief sections: (1) the Matins, (2) Lauds, (3) Little Hours and (4) Vespers and Compline. At present only a very few of the old dioceses retain their own breviaries.

**BREWER, DAVID JOSIAH** (1837-1910), American jurist, was born at Smyrna, Asia Minor, June 20, 1837. He graduated at Yale in 1856 and at Albany Law School in 1858 and began practicing law at Leavenworth, Kansas, where he served as judge of the probate and criminal courts in 1863-4. Beginning in 1889 he served twenty-one years as a justice of the United States Supreme Court. During this period he served as president of the Venezuela Boundary Commission appointed by President Cleveland, and during 1895-98 was a member of the arbitration tribunal to decide the boundary between British Guiana and Venezuela. He died at Washington, D.C., Mar. 28, 1910.

**BREWER**, a city in Penobscot Co., southern Maine, situated at the head of navigation on the Penobscot River, opposite Bangor. Ferries and the Maine Central Railroad serve the city, and two steel bridges span the river from Brewer to Bangor. Paper and pulp manufacture and wood-working are the chief industries. Brewer was separated from Orrington and incorporated in 1812. The city's charter was granted in 1889. Col. John Brewer, for whom the city was named, was the first postmaster. At one time Brewer had important shipbuilding and lumber shipping industries. Pop. 1920, 6,064; 1930, 6,329.

**BREWSTER, SIR DAVID** (1781-1868), Scottish physicist, was born at Jedburgh, Dec. 11, 1781. He was educated for the ministry but turned to science, in 1808 becoming editor of the *Edinburgh Encyclopaedia*. He devoted himself principally to the study of optics, discovering certain laws of light polarization. He established the connection between the index of refraction and the angle of polarization, the double refraction caused by heat and pressure upon the refracting medium, and found crystals with double axes of double refraction. In 1815 Brewster was elected to the Royal Society, receiving the Rumford Medal in 1818, and in 1831 was prominent in establishing the British Association for the Advancement of Science. In 1859 he became principal of Edinburgh University. His writings include *Letters on Natural Magic*, 1831, *Treatise on Optics*, 1832, *Life of Sir Isaac Newton*, 1832, and *Martyrs of Science*, 1841. He died at Allerby, near Montrose, Feb. 10, 1868.

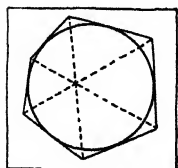
**BREWSTER, WILLIAM** (c. 1566-1644), leader of the Pilgrims, was born at Scrooby, England. After studying at Cambridge, he was secretary to William Davison, until the latter's disgrace in 1587, resulting from the execution of Mary Stuart. Brewster then

returned to Scrooby, and became leader of a Separatist congregation, which had broken away from the Established Church in 1606. They emigrated to Holland in 1608, and at Leyden, Brewster became the elder and teacher of the new church. In 1619 he narrowly escaped arrest with a business partner for having printed books banned in England. He made his way to London where he secured a patent of colonization for his church associates from the Virginia Company. In 1620 he sailed on the *Mayflower* as leader of the expedition. At Plymouth he was the only church officer until 1629, and, although never a minister in the Pilgrim sense of the word, he remained throughout his life the real leader of the church at Plymouth. He died on April 10, 1644.

**BREZINA, OTTOKAR** (1868-1929), pen name of Václav Jevávy, Czech poet, who was born Sept. 13, 1868, at Pocatce, Bohemia. He lived as a teacher of a secondary school in Jaromerice, Moravia. Brezina is conceded to be the greatest of the Czech moderns, a symbolistic lyricist of profound thought and extraordinary beauty and power of expression. By some critics he is hailed as the greatest poet of his time in Europe. His best known works are *Secret Distances*, *The Hands* and *Music of the Springs*. The poet died in 1929.

**BRIAN BOROIMHE** or **BORU** (926-1014), King of Ireland, in his youth engaged in the defense of Munster against the Danes. He succeeded Mathgamkain, his brother, as king in 978. In a campaign against the Danes, he brought Munster and Leinster under his rule. In 1001 he conquered Maelseclainn, the chief king of Ireland. Annexing Connaught and Ulster, he caused himself to be proclaimed chief king by exacting tribute from the majority of the minor kings. After defeating the Danes in the decisive battle of Clontarf in 1014, he was murdered in his tent.

**BRIANCHON'S THEOREM**, an important theorem discovered by Charles Julien Brianchon (1783-1864) and published in 1806. It states that if a hexagon be circumscribed about any conic section, the three lines determined by the three pairs of points, or vertices, meet in the same point. It is here shown for a circle a figure of which any shadow is a conic section, the property being the same (invariant) in all cases. It is one of the first and best-known examples of DUALITY. See PASCAL'S THEOREM.



HEXAGON CIRCUM-  
SCRIBED ABOUT A  
CIRCLE

**BRIAND, ARISTIDE** (1862-1932), French statesman, was born at Nantes on Mar. 28, 1862. Educated for the law, he identified himself with Socialism, and wrote for *Le Peuple*. With Jean Jaurès he founded *L'Humanité*. From 1894, when he persuaded the Socialists to practice the idea of the general strike, he was a leader of the party. As a proponent of the doctrine of the separation of Church and State, Briand became minister of public instruction under Sarrien in 1906, which led to his exclusion from the Unified

Socialist party. In October of the same year he again accepted the portfolio in Clémenceau's first government, and carried out the Separation Law without alienating the Vatican. In 1908 he became minister of justice, and the next year he formed his first ministry, settling the railway strike dispute in 1910. He was premier in 1913 under President Poincaré, retired from March until October 1914, and again became premier. In 1917 he retired, and took little part in civil affairs. He returned to public life in 1921, accepted the premiership and attended the Washington Disarmament Conference as the French agent. He resigned in 1922 but returned as minister of foreign affairs under Painlevé. In 1925 he was largely responsible for the Locarno agreements, and for this accomplishment received the Nobel Peace Prize. Out of his proposal for a Franco-American pact to renounce war as between themselves came the Briand-Kellogg Peace Pact, signed in Paris, on Aug. 27, 1928, by which the 15 leading nations of the world solemnly renounced war as an instrument of national policy. In September 1929, during the 10th assembly of the League of Nations at Geneva he promulgated his idea for economic union among European nations, the "United States of Europe." In 1929 he served as premier, in 1930 as minister of foreign affairs under Tardieu, and in 1931 as minister of foreign affairs under Laval, always exerting great influence on account of his legislative experience and wide knowledge of international relations. Briand died at Paris Mar. 7, 1932.

**BRIANSK**, industrial and administrative center of Briansk district in the Western Region of the R.S.F.S.R., on the right bank of the Desna River. The large number of factory workers made Briansk in pre-war days the center of revolutionary disturbances. In the many suburbs are cement and glass factories and iron foundries. Traces of old fortifications, a 17th century cathedral and two fine monasteries are interesting historically. In the district museum is the Mechanical Construction Technical Institute. The Zvensky Monastery nearby has remarkably fine icons. Pop. 1926, 47,703.

**BRIAREUS**, sometimes called Aegaeon, was a son of URANUS, and so a member of the family of Uranids who were giants with 100 arms. Assisting ZEUS in his war on the TITANS, the Uranids gained the victory by hurling 300 rocks at once. The prowess of Briareus and his brothers probably symbolizes geological commotions like earthquakes and eruptions of volcanoes. Modern scholarship suggests that the monstrous shape of Briareus was derived from the octopus.

**BRIBERY**, receiving or offering a reward to any one whose profession or business has to do with the administration of public justice in order to influence his behavior in office. The term has now been given more extensive meaning and includes the giving or offering of such a reward to officials generally. It applies both to the one who gives and the one who receives, and has been extended to selling votes.

**BRICES CROSS ROADS**, a national monument near Baldwin, Mississippi, commemorating the Civil War battle of Brices Cross Roads fought in this locality, June 10, 1864. The monument, which has an area of one acre, was established February 21, 1929, under the administration of the War Department. It is reached by the Mobile and Ohio Railroad.

**BRICK**, the oldest known of the building materials, served the aborigines as a base for inscribing their records. The first bricks were unburned; clay was mixed with straw, hand-molded, and sun-dried. Machine produced bricks were not made until about 1850. In America the brick industry did not get well under way until the latter portion of the 19th century, and crude methods of manufacture continued until the advent of the World War. The stimulus given to research brought about great changes in the manufacture of all types of brick products. Common bricks are being made of lighter weight and of greater insulating value, and can be burned in large units at a low cost, at many points still providing the cheapest material for backing walls.

The raw materials for the manufacture of brick products are clays, shales, fire clays, kaolin, and high alumina clays. While most types of clays and shales can be used in the manufacture of common brick, only a few types are suitable for the manufacture of vitrified face brick. It has recently been determined that by the addition of blast furnace slag to fire clays, unusually high grade face brick can be made from materials hitherto not suitable in themselves. This is caused by the lowering of the fusion temperature of clay by the slag, which acts as a flux.

The sand lime-brick, made from sand and lime, machine-molded and steamed under pressure, provides at some points the supply for both common and the facing brick. Insulating brick is made from infusorial earth or from mixtures of clay and sawdust, and burned, while new processes have been developed to make lightweight brick by fusing and molding molten clay. Acid-resisting brick and paving brick are usually made from shales or stone-ware clays, which vitrify and are impervious to acids. The Georgia high-alumina clays afford the largest future source of supply for refractory brick. Bricks are usually made by the soft mud, stiff mud, or dry press processes. See also **FACING BRICK**; **FIRE CLAY BRICK**; **PAVING BRICK**. P. M.

**BRICK, CONCRETE.** See **CONCRETE PRODUCTS**.

**BRICK, REFRACTORY.** See **FIRE CLAY BRICK**.

**BRICK PAVEMENTS** have a surface of brick burnt to the point of vitrification. Such brick are tough and weather-proof, absorbing less than two per cent moisture. The brick are laid on a **PAVEMENT BASE** in a cushion of sand, stone-screenings or bituminous mastic rolled to a true surface. The joints are filled with **Portland CEMENT** grout, or with **BITUMINOUS MATERIAL**, poured, "squeezed" hot, and covered with hot sand.

Brick pavements, four inches thick, have given good service for 20 to 35 years. They are also laid 3

and 3½ in. thick for light traffic. Cheaper than **GRANITE BLOCK**, they are generally more expensive than **ASPHALT PAVING**.

**BRICK TESTING** comprises the "rattler" test on paving brick and the absorption, flexure and compressive strength tests on building brick.

**Rattler Test.** Ten brick are selected at random, dried and weighed. The rattler consists of a 14-sided barrel approximately 27 in. in diameter and 20 in. in length, inside measurements. The "charge" consists of 300 lb. of cast iron spheres of two sizes. The barrel with the 10 brick and the charge is run for 1800 revolutions at 30 revolutions per minute. All brick and pieces weighing 1 lb. or more are weighed. The test value is the percentage loss based on the original weight. Larger brick lose less than small ones of the same quality.

**Absorption Test.** Five whole brick are dried, weighed separately, immersed in water for 5 hours, surface dried, and weighed again. The percentage absorption is based on the dry weight.

**Compression Test.** Five half brick selected from different brick are shellacked on the surfaces to be loaded, after which these surfaces are bedded in plaster of paris. The specimens are loaded to failure in a vertical type testing machine. The load in pounds per square inch is taken as the compressive strength.

**Flexure Test.** The test specimen is a whole brick, and five constitute a set. The brick is placed flat on knife edges 7 inches apart. The load is applied at mid-span until failure results. The flexure test result is the *modulus of rupture* computed from the formula

$$R = \frac{3Wl}{2bd^2}$$

in which  $W$  is the total load in pounds,  $l$  the distance between knife edges in inches,  $b$  the width of the brick in inches, and  $d$  the depth of the brick in inches.

E. E. B.

**BRICKWORK.** Brick is adapted to a variety of uses in the construction of buildings, being used for exterior and interior walls, fireproofing, backing up other materials, and decorative effects. The possibilities for the artistic treatment of wall surfaces are not even limited by the wide range of color and texture of brick, for, with the use of a given brick, wide variations in color effect and texture may be obtained by varying the size, design and color of the mortar joint. For example, a raked-out gray mortar joint will not only give a rougher texture to a wall but will also give a darker color effect than if the same mortar be cut flush with the face of the brick.

The word "brick," as ordinarily used, refers to a rectangular prism of **CLAY**, **SHALE**, which is a form of clay, or a combination of these, burned in a **KILN**. Until comparatively recent years, practically all brick were "hard-burned" clay brick. Brick, however, is now made in which the base is of other material than clay, and when such units are referred to, a descriptive prefix should be used in connection with the word brick, as, e.g., fire brick, **SLAG** brick, **Silica** brick, **Cement** brick, sand-lime brick, and the like.

Brick for building purposes may be divided into two classes: "Common" brick is the brick most extensively used for the construction of walls, piers, etc.; for backing up stone and *TERRA COTTA*; and for fireproofing of steel and iron. In the Eastern States, it is usually red—the depth of color, however, depending upon the composition of the clay, the method of manufacture, and the degree of burning. In the Middle West, common brick is usually yellow. The color varies with the clays.

"Face" brick is the brick used on the exposed surface. Common brick are also used as face brick, in which case the brick of the desired character for the effect to be obtained are usually selected either at the kiln or from those intended for the solid wall. As the term "face" brick is generally understood, however, it means a brick especially made for its color, surface texture, and regularity of size, as may be required to produce the desired effect on surfaces exposed to view.

G. A. H.

**BRIDAL WREATH** (*Spiraea prunifolia*), a small shrub of the rose family native to China and Japan and widely cultivated for ornament. It grows about 5 ft. high bearing a profusion of pure white flowers in small clusters, which appear in advance of the finely toothed plumlike leaves. Sometimes a second crop of flowers is produced in autumn.

**BRIDE OF LAMMERMOOR, THE**, a romance of weird tragedy, by SIR WALTER SCOTT; published 1819. Edgar, Lord Ravenswood, the last scion of a proud family—reduced, however, by poverty to the eerie Wolf's Crag and a single servant, the comic Caleb Balderstone—pledges his troth with Lucy Ashton, the daughter of his father's bitterest enemy. Lucy, betrayed by her grasping parents into a marriage with the wealthy Sir Arthur Bucklaw, is crazed with grief, kills the bridegroom on the wedding night, and then herself falls dead. The book ends when Ravenswood, in despair, gallops into a stretch of quicksand. *Lucia di Lammermoor*, an opera by GAETANO DONIZETTI, is based on the novel.

**BRIDGE, AUCTION BRIDGE AND CONTRACT BRIDGE** are the second, third and fourth of a series of card games of the whist family. The parent game, WHIST, traces its history back through the centuries, and even to-day has its scattered devotees. Bridge, the second in the line of succession, has died out entirely. Auction and contract have superseded them.

Bridge was introduced in England about 1886; but its place of origin is apparently somewhat in doubt. It was about 10 years before the game became popular in the London clubs, and a few years later it was taken up by the English card-playing public. About the end of the last century it took root in America and spread with great rapidity, in a short time practically superseding whist. That first form of bridge differed from whist in the following essential particulars: (1) A hand might be played without a trump, all suits having equal winning power; (2) the cards of one player were placed face-up on the table as dummy, and the

partner of that player played them as well as his own; (3) instead of counting one point each, the odd tricks, or tricks over the book of six, counted 2 points each when the trump was spades, 4 each for clubs, 6 for diamonds, 8 for hearts, and 12 points for each trick when there was no trump; (4) the dealer, or his partner if the dealer failed to do so, named the trump or no trump, and the opponents had the right to double the value of the tricks, after which the making side could redouble and this doubling process, theoretically, could be carried on *ad infinitum* although by agreement the trick values generally were limited to 100 points each; (5) honors, or the five highest cards of the trump suit or the four aces in no trump, were given a value counted "as held"; there was an extra allowance of 100 points for winning a rubber. Either side could score toward game the value of their odd tricks, 2 for each trick when spades was the trump, 4 for clubs, 6 for diamonds, 8 for hearts and 12 for no trump. A game consisted of 30 points made by tricks alone.

**Introduction of Auction Bridge.** Bridge was very popular on both sides of the Atlantic for about a dozen years and then auction bridge was introduced. Auction bridge is said to have been invented in India as a three-hand game, the three contestants bidding for the privilege of naming the trump, or no trump, and playing the dummy. That game was mentioned in London newspapers as early as 1903; and in 1907 was made into a four-hand game by the Bath Club. The Portland Club in London took up auction in 1907, and its rules for auction, and more recently for contract, have had an authoritative status in England similar to that of The Whist Club (New York) in America, the term America in this case meaning the United States and Canada. In taking up auction bridge early in the present century, America at first adopted the British rules; but in 1910 the Whist Club promulgated American rules which were revised or amended in 1911, 1912, 1913, 1915, 1917, 1920 and 1926.

The radical changes introduced when auction superseded the original bridge were: (1) Determining the privilege of naming the declaration by competitive bidding open to both sides, instead of reserving the right of nomination to the dealer's side; (2) permitting only the declarer's side to score toward game (below the line), and allowing a penalty score (above the line) to the adversaries if the declarer failed to make good his contract; (3) restricting the doubling to one double and one redouble.

The American revisions made in 1911, 1917 and 1920 contained nothing radical; but those of 1912, 1913, 1915 and 1926 were milestones on the road of progress of auction bridge in America. In 1911 the Racquet Club of Philadelphia broke away from the 2, 4, 6, 8, 12 trick valuations which had been carried over from bridge, and adopted values of 6, 7, 8 and 10 for clubs, diamonds, hearts and no trump respectively; giving the spade suit a dual value of 2 and 9, and calling the higher value declaration royal spades

or royals. The Whist Club adopted this amendment in 1912 and made it part of the official code, but in 1915 abandoned the dual value of spades and the term royals. From that time on in America spades has been the highest suit, odd tricks in it being rated as 9 each. The Portland Club also experimented with royals, but discarded the dual spade valuation in 1924 and adopted the 6, 7, 8, 9, 10 values.

This alteration in suit values changed the complexion of the game materially. With the values of 2 and 4 respectively it was impossible to go game in either spades or clubs from a love, or zero, score, even by making a grand slam, or 13 tricks. Under the new count, the declarations automatically divided themselves into three groups: no trump requiring three-odd for game; the major suits, spades and hearts, requiring four-odd, and the minors, diamonds and clubs, requiring five-odd. This is the count used to-day and as will be seen below, this grouping was preserved with higher valued tricks in contract.

In 1913 the American code was rewritten to secure better arrangement and greater clarity; and incidentally the count for chicanes was eliminated and the revoke penalty reduced to 100 points. In 1915 the slam bonus was increased, and numerical overcalling adopted. Prior to that time it was necessary to multiply the number of tricks bid for by the value of each trick in order to ascertain which of two bids was the higher; in case of a tie, the bid for more tricks prevailed. Thus 3 clubs, 3x6, would not overcall 2 no trump, 2x10; but 4 clubs, 4x6, would overcall 3 hearts, 3x8. After the 1915 revision, any bid for more tricks overcalled a bid for fewer tricks; and in case of equality in the number of tricks bid for, the several declarations ranked in the following order: clubs, lowest; diamonds; hearts; spades; no trump, highest.

In 1928 the Portland Club made a canvass of the English clubs to ascertain the sentiment toward adopting the American majority calling, as it was styled in that country. A slender majority favored the change; but the Portland Club decided against it on the ground that such an innovation should not be adopted until the demand for it became more insistent. They did, however, make majority calling optional although not official, and many English clubs proceeded to use it.

Another revision of the American auction code was made in 1926 and embodied the following major alterations: (1) The suit honor values were fixed at multiples of 10 instead of multiples of trick values, making honor counts 10, 20, 30, etc. for suit honors as well as no trump honors; (2) revoke penalties were made payable in tricks instead of points, and such tricks were counted, the same as if won in play, by either the declarer or the defending side for the purpose of making or defeating the contract, or making game or slam; (3) the rank of cards was made uniform for all purposes, ace being high and deuce low, the high card carrying preference in drawing for deal and choice of seats. The suits retained their rank, spades, high; hearts; diamonds; clubs, low, to decide ties in drawing. The 1926 code also cleared up sev-

eral ambiguities of law interpretation, and in its compilation the Whist Club had the benefit of collaboration by the American Whist League and the Knickerbocker Whist Club (New York).

**Contract Supersedes Auction.** For some years prior to 1926, reports reached America of a French variety of auction which was called *Plafond* and a similar variety in some other countries called contract. The essential features of this game were a provision that the declarer could score toward game no more tricks than he had bid, and a tremendous premium for successful slam bids. America was skeptical; nevertheless the new game was tried by groups here and there, and at least two sets of tentative American laws came into existence. The innovation was christened contract, and during the summer of 1926 was played extensively at fashionable resorts where the rules used were substantially the same as those codified by the Whist Club in 1927. During the following winter contract bridge obtained a substantial foothold, and from then on its adoption by American players increased in geometric ratio, with every evidence in 1931 that contract would soon win over the great majority of all auction players.

Contract was such a revolutionary departure from auction that the two were regarded as separate games from the beginning, despite the play of the cards being identical. The great difference between auction and contract has to do with the bidding and scoring. In contract bridge the game is 100 points; tricks in the two minor suits count 20 each, requiring five-odd for game; in the major suits 30 each, four-odd for game; in no trump 35, three-odd for game. One double and one redouble are permitted.

In auction the declarer scores toward game all tricks won regardless of the number bid for. In contract he scores toward game only the number bid for, his extra tricks, if any, being scored with his honors. In both games the declarer scores nothing toward game when his contract fails, and in both there is a premium, apart from the score for extra tricks, for making a doubled contract. In auction the bonus is 50 points, or 100 if redoubled; in contract the premium is 50 points if the declarer is non-vulnerable, or 100 if vulnerable, both premiums being doubled when there is a redouble. The contract rubber premium is 700 for winning a two-game rubber, or 500 for winning two games to one. A side is vulnerable when the game score is one to nothing in its favor; when the games stand at one-all, both sides are vulnerable. The premiums and penalties of a vulnerable side are greater than those of a non-vulnerable side.

The rubber premiums are so high, and likewise the slam premiums, 500 to 1500 points, that a strong deterrent is needed against flag flying. Consequently the undertrick penalties, for failure to make good the contract assumed, are arranged in a rapidly ascending scale; ranging from 50 points for the first undertrick of a non-vulnerable undoubled declarer, up to 400 points for the fifth and subsequent undertricks of a doubled non-vulnerable declarer, and 400 for the sec-



ond and subsequent undertricks of a doubled vulnerable declarer. Redoubling multiplies these tremendous penalties by two. Trump honors count only if there are four in one hand, 100 points; or five in one hand, 150 points; only four aces in one hand, 150 points, are counted at no trump. The revoke penalty is 2 tricks for the first, and 100 points for each subsequent revoke.

The contract extra trick and slam premiums, and the undertrick penalties are as follows:

*Extra Tricks:*

If undoubled (When declarer is vulnerable or not vulnerable), per trick..... 50

If doubled (When declarer is not vulnerable), per trick..... 100

If doubled (When declarer is vulnerable), per trick... 200

*Slams Bid and Made:*

Little Slam (When declarer is not vulnerable).... 500

(When declarer is vulnerable)..... 750

Grand Slam (When declarer is not vulnerable)....1000

(When declarer is vulnerable).....1500

*Undertricks:*

If undoubled (When declarer is not vulnerable), per trick..... 50

If undoubled (When declarer is vulnerable), for first trick..... 100

for subsequent tricks, per trick..... 200

If doubled (When declarer is not vulnerable), first

two tricks, per trick..... 100

for third and fourth tricks, per trick..... 200

for subsequent tricks, per trick..... 400

If doubled (When declarer is vulnerable), for the

first trick..... 200

for subsequent tricks, per trick..... 400

In the days of whist in America, duplicate and progressive were played a great deal; and these two variations were applied extensively to auction and contract as those games became popular. Rules for these variations of the standard rubber game were promulgated by the American Bridge League.

The official contract laws provide for an optional variation called the goulash. Instead of abandoning the hand to the next dealer when all four players pass their first opportunity to make a bid, players may elect before the game starts to play a goulash. In a goulash all players sort their hands into suits and each in turn, beginning with the dealer, places his cards in a common pile face down. The same dealer deals again after the cards are cut, but not shuffled, giving each player in turn five cards, then five more, and finally three. After that the bidding and play proceed in the regular way. Abnormal hands are produced by goulash dealing, and the resultant scoring averages much higher than in the ordinary course of the game.

M. C. W.

**BIBLIOGRAPHY.**—Milton C. Work, *Bridge Pointers and Tests*, *Auction Bridge for Beginners*, *Auction Bridge Complete* and *Common Sense Contract Bridge*.

**BRIDGE-BUILDING BROTHERHOOD**, a name for various confraternities, not religious orders, organized during the 12th and 13th centuries for the assistance of travelers, especially pilgrims, as well as for the avowed purpose of constructing bridges. There were usually three grades of membership: knights, or *donati*, the chief contributors of alms;

clergy; and artisans, and in some cases "sisters." One association, called explicitly *Fratres Pontifices*, i.e., brothers bridge-builders, were active in the south of France. See **PONTIFF**.

**BRIDGE OF SIGHS, THE.** 1. In Venice, a high, covered, arch-shaped bridge over which condemned prisoners passed on their way from the Doge's Palace to the State Prison. It is mentioned in the opening lines of Byron's *CHILDE HAROLD'S PILGRIMAGE*. 2. The title of a poem by THOMAS HOOD referring to Waterloo Bridge, London, famed for its suicides. 3. In New York City, the covered bridge which connects the Tombs Prison with the Court House.

**BRIDGEPORT**, a port and manufacturing city in southwestern Connecticut, the county seat of Fairfield Co., situated on Long Island Sound, 56 mi. northeast of New York City. The New Haven Railroad, bus and truck lines and ferries to Long Island afford transportation. There is an airport. The city's varied manufactures include brass and bronze products, ammunition, airplanes, sewing machines, drugs, electrical goods, corsets, plated ware and hardware. The factory output, 1929, amounted to \$176,258,794. Retail business, 1929, was valued at \$81,191,741; wholesale trade at \$32,753,626. The commerce of the harbor, 1930, amounted to \$133,688,717. Bridgeport was founded in 1639; incorporated as a borough in 1800 and as a city in 1836. During the World War firearms and ammunition were extensively manufactured in Bridgeport. Pop. 1920, 143,555; 1930, 146,716.

**BRIDGEPORT**, a borough in Montgomery Co., southeastern Pennsylvania, situated 17 mi. north of Philadelphia on the Schuylkill River and served by an electric line and the Philadelphia & Reading Railroad. It is an industrial center with cotton, woolen, steel and paper mills. Washington and his troops marched through Bridgeport on their way to Valley Forge, which to-day is a state park. Pop. 1920, 4,680; 1930, 5,595.

**BRIDGES, ROBERT** (1844-1930), English poet laureate, was born in the Isle of Thanet, Oct. 25, 1844. He was educated at Eton and Oxford, studied medicine and reached eminence as a physician, but after 1882 devoted his time entirely to literature. His *Prometheus the Fire Giver* appeared in 1883, followed by five plays, the best known of which is *Nero*, 1885. His *Shorter Poems*, a collection of lyrics, was published in 1890. In 1913 he was appointed poet laureate, and his work was collected in one edition in 1914. His *New Verse* appeared in 1925, *The Testament of Beauty* in 1929. Bridges was a great master of the poets' technique and continually experimented with new meters. His lyrics are classic in their expression of lofty, self-contained joy. The poet died near Oxford, Apr. 21, 1930.

**BRIDGES**, structures built to carry railway and highway traffic over rivers, waterways, or valleys. They consist of simple trusses, cantilever spans, **ARCH BRIDGES**, **SUSPENSION BRIDGES**, **DRAW BRIDGES**, and **VIA-DUCTS**, the particular type depending upon its suit-

ability to the length of the spans from pier to pier, the character of the traffic, the clearances required for boats, and the economies of construction. Bridge piers are "founded" by means of COFFERDAMS or CAISSONS.

The first bridges were probably flat slabs of stone laid for the crossing of small gullies; and in timber countries, large fallen trees were used for passage over gulches. Grapevine or bamboo suspensions, spanning narrow streams, were probably employed as early as any other type. The first real bridges, in the modern sense, were undoubtedly the stone arches built by the Chinese and the Persians. Chinese bridges generally spanned small streams and canals and were built high enough to allow boats to pass beneath, having steep steps for foot traffic. The white marble Camel Back bridge in the Imperial Palace grounds at Peiping is especially noteworthy.

The Persian bridges were more pretentious. Sometimes of considerable total length, they had many short-pointed, or "gothic" arches. The crossing was placed at a shoal in the stream, and rock was piled roughly in a large mass, forming the base for each pier. The bridge at Dizful should be noted, and the one at Shuster over the river Karun is of considerable length.

The greatest era of early bridge building was the Roman. Furthering their policy of military expansion, the Romans built roads which crossed streams by means of stone bridges. The bridge of Augustus at



COURTESY M. M. OF ART

JAPANESE DRUM BRIDGE  
From a print by Hiroshige

Rimini is still standing in a good state of preservation, as is the bridge of St. Angela at Rome. The longest span—251 feet—built by them was at Trezza, Italy, over the River Adda.

Many of the stone arched structures built by the Romans were for AQUEDUCTS. The remains of many of these are still in existence, as at Nîmes, France, over the river Gard. This is built in three levels with a highway crossing on the lowest, which has spans up to 80 ft. in length. Recently the roadway was widened with concrete to accommodate motor traffic.

During the middle ages, bridge construction followed the methods begun by the Romans. However, larger structures were built, as, e.g., the bridge at Avignon, France, of which about half is still standing. The first stone bridge at London, 1176, had a length of 926 feet, the longest span being less than 30 feet. About two-thirds of the width of the river was taken up by the piers.

There was considerable improvement in the construction of bridges by the beginning of the 18th century, but it was not until 1739 that the scientific investigation of arches began.

The next great era of bridge building began under Napoleon. The engineers of the Ponts et Chaussées, built many notable stone bridges in various parts of the Empire. The three iron bridges in Paris were the beginning of metal bridge construction, although a cast iron English bridge was built at Coalbrookdale in 1777. The first great metal bridge was the 579.8 foot suspension span over Menai Straights, completed by THOMAS TELFORD in 1825, and still standing. The cables were formed of iron bars 10 feet long. The first notable railway bridge was built in 1846 by ROBERT STEPHENSON, assisted by WILLIAM FAIRBAIRN. It is still in use and has four rectangular tubular spans for double track, and the center spans are 460 feet long. The calculations of Fairbairn are the basis of modern steel bridge designings.

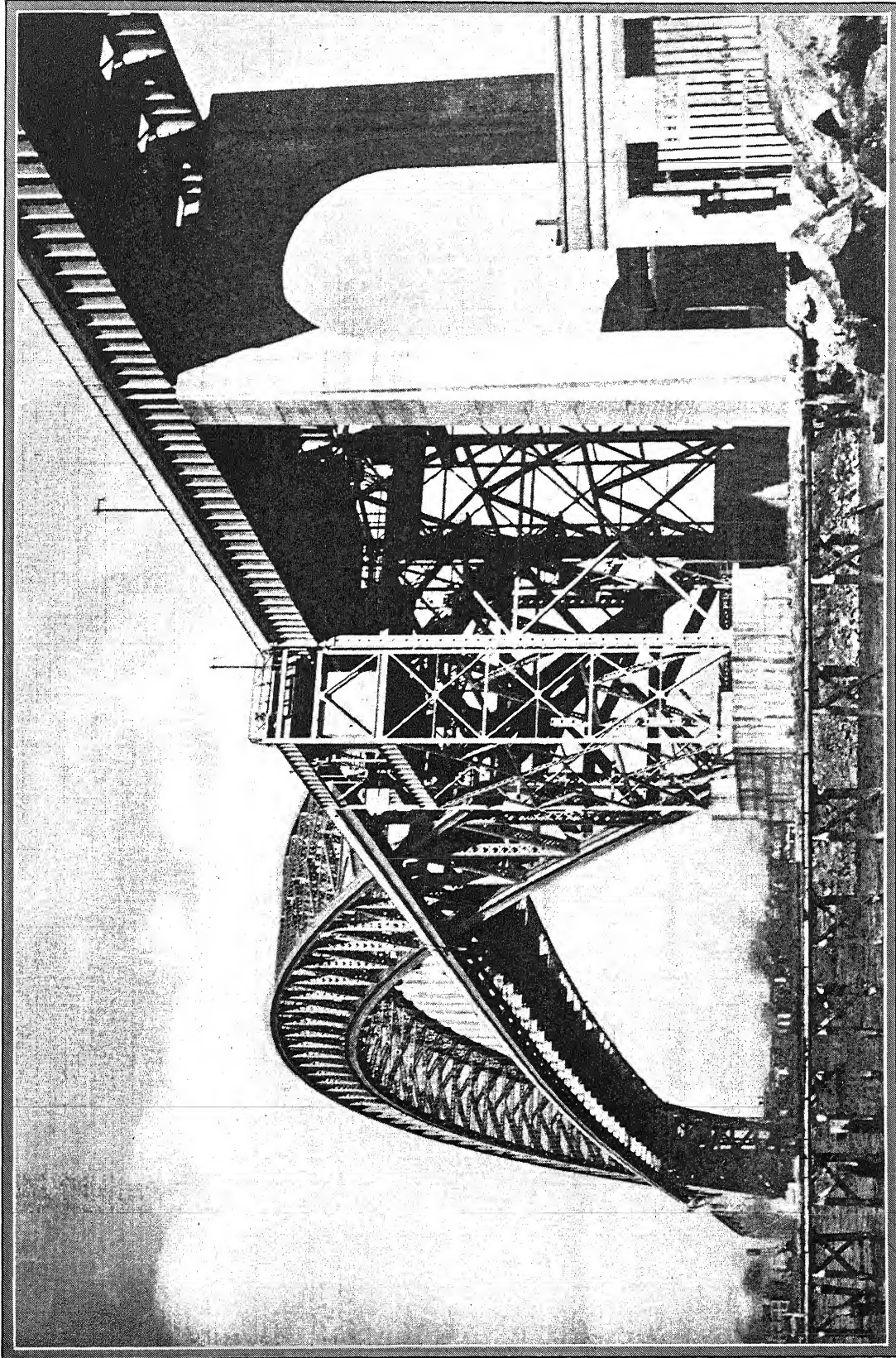
The science of bridge mathematics was very greatly developed by W. J. M. RANKINE, while subsequent theoretic improvements have made it possible to correctly calculate the size of each member of a bridge. The great railway cantilever bridge over the FIRTH OF FORTH, completed in 1888 by JOHN FOWLER and Benjamin Baker, has two main spans of 1710 feet each.

The suspension bridge over the East River designed and built by J. A. ROEBLING, has a span of 1595.5 feet and was completed in 1884. The cables are of steel wires laid parallel in four round cables of 18 inches in diameter. The Washington suspension bridge across the Hudson River has a span of 3500 ft. carried on wire cables 36 inches in diameter. The proposed suspension span across San Francisco Bay, 4850 feet between towers, would be carried by eight wire cables of 22 inches in diameter. The longest suspension span economically possible would not much exceed 5000 feet. The longest cantilever span, 1800 feet, is at Quebec, Canada, and the longest proposed span of this type is 2400 feet. The famous Hell Gate bridge at New York has a span of practically 1000 feet. The new Sydney, Australia, arch bridge will have a span of 1650 feet while the Kill Von Kull arch at New York City has a span of 1675 feet.

Among the longest arch spans so far constructed of re-enforced concrete are the one at Descize, France, which has a span of 183.7 feet, the bridge at Gruenwald, Bavaria, a span of 230 feet, and the 150-foot span at Pittsburgh.

The bridges over large rivers near their mouths, where ships must pass, are usually so built to allow high funnels and masts to clear. In case low level bridges must be used, the passage for vessels is provided for by the use of movable spans of the lift, the BASCUL, or the ordinary draw bridge types. The bridges of the bascule type are often built with two "leaves," and with a clear opening of from 200 to 250 feet. The Michigan Avenue bascule bridge, Chicago, is a fine example of this type, though the Tower Bridge, London, is also notable.

## BRIDGES

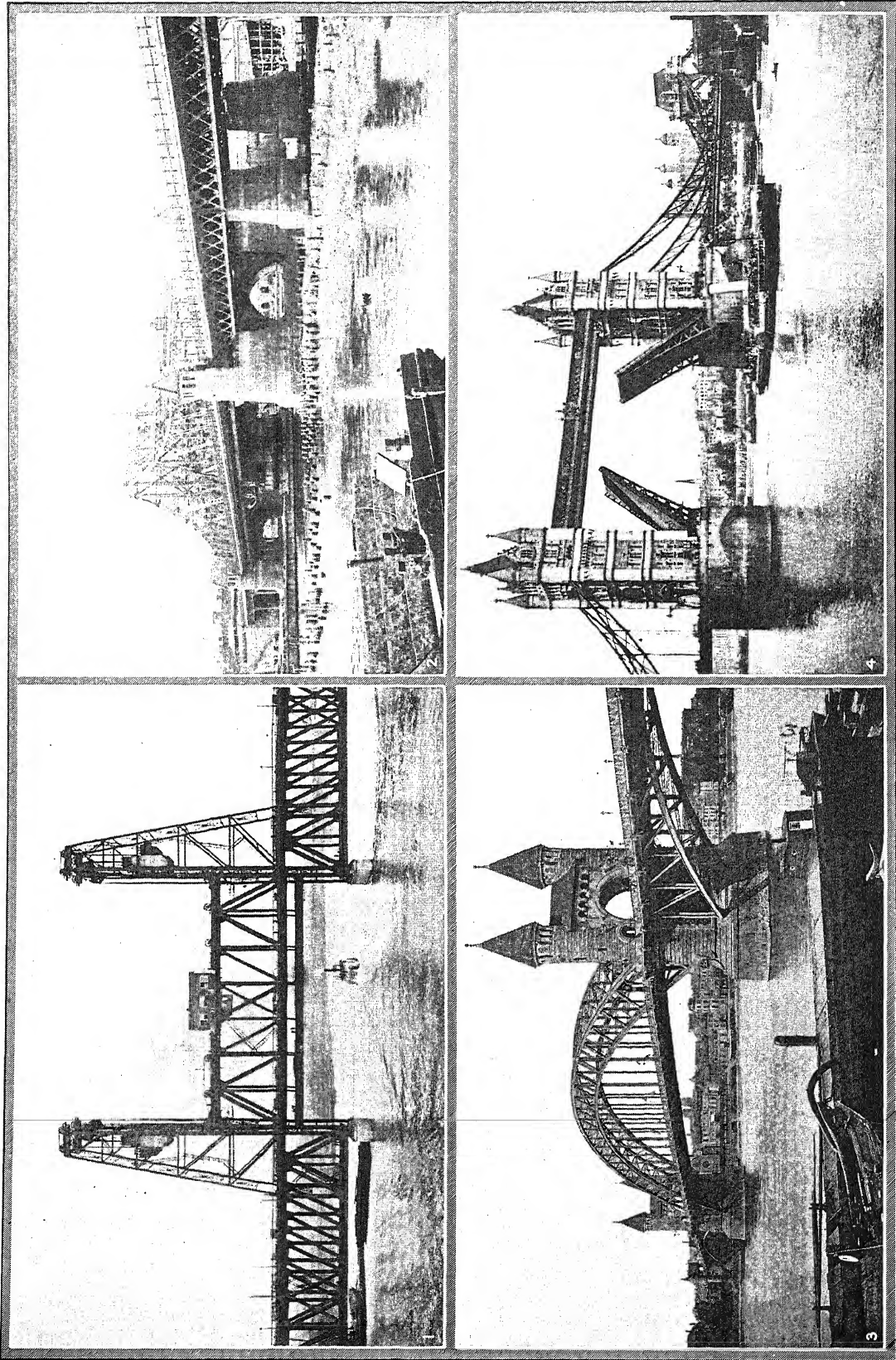


CHARLES PHELPS CUSHING PHOTO

### WORLD'S LONGEST ARCH SPAN

The Kill van Kull steel arch bridge between Bayonne, New Jersey, and Port Richmond, Staten Island. The span is 1,675 ft. long and 150 ft. above the water. The total length is 8,100 ft. It was opened in November, 1931, and cost \$16,000,000.

## BRIDGES



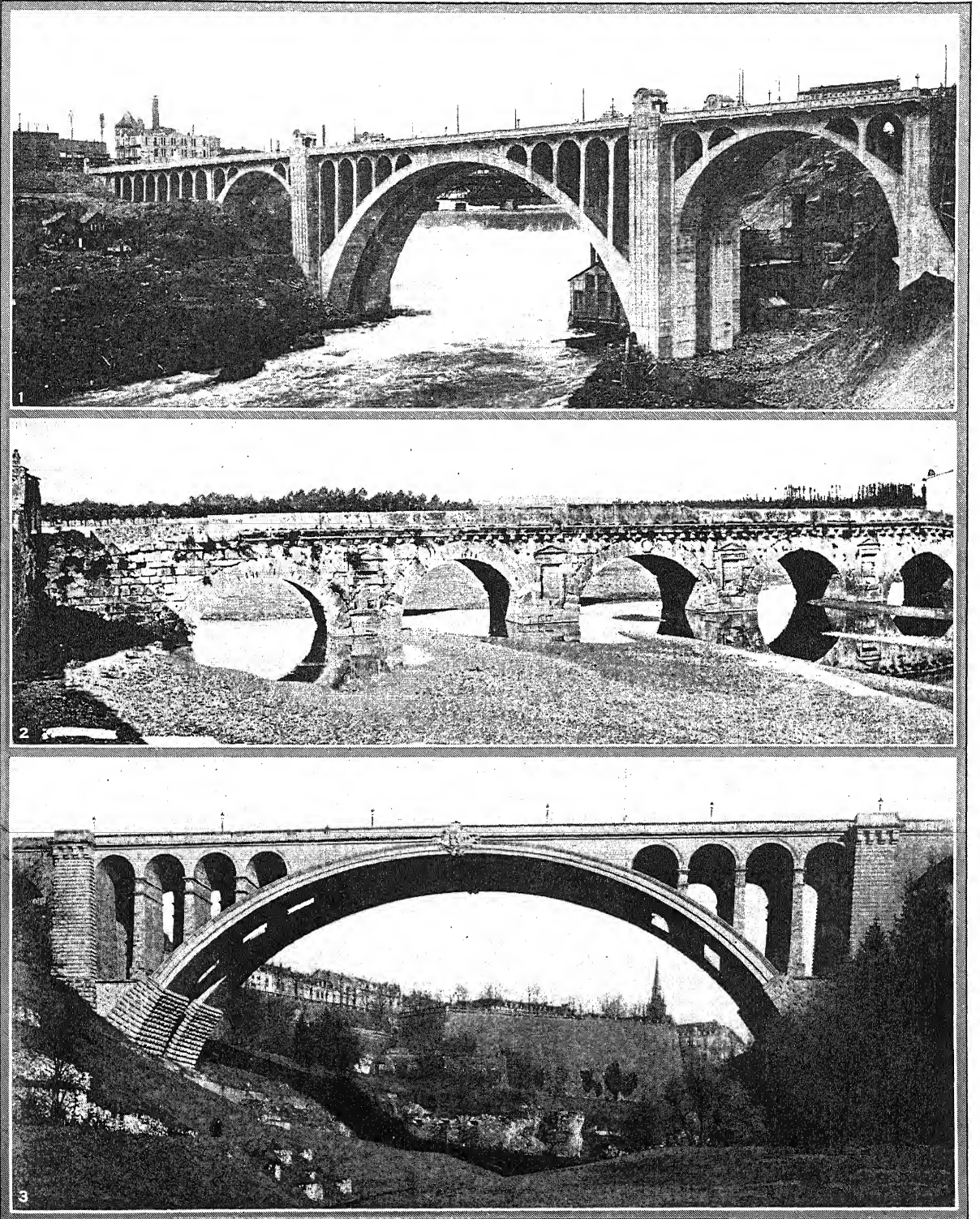
C. E. FOWLER PHOTOS

### FOUR TYPES OF BRIDGE CONSTRUCTION

1. The Oregon Railroad and Navigation "lift" bridge at Portland.
2. Swing bridge, spanning the Harlem River, New York City.
3. The Rhine Bridge at Bonn, Germany, with central span of 615 ft.
4. Tower Bridge, London, a trunnion bascule structure built in 1885-94.



## BRIDGES



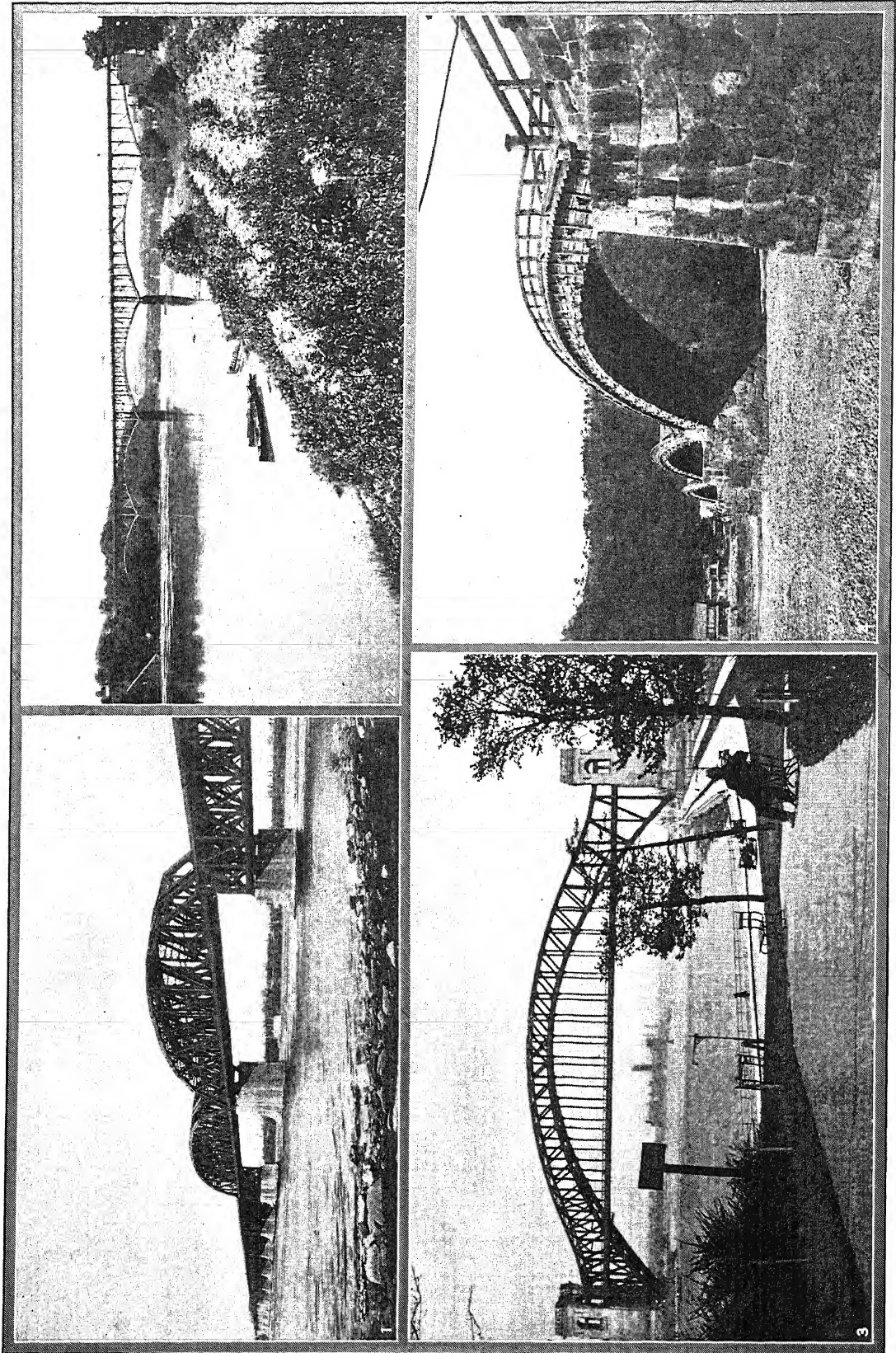
C. E. FOWLER PHOTOS

### FAMOUS ARCHED BRIDGES IN THE UNITED STATES AND EUROPE

1. The Monroe Street Bridge over the Spokane River at Spokane, Washington.
2. The marble arched bridge of Augustus spanning the Marecchia River at Rimini, Italy.
3. The Pont Adolphe at Luxembourg, with a central span of 275 feet.



# BRIDGES



1, 2, 4, C. E. FOWLER PHOTOS; 3, CHARLES PHELPS CUSHING PHOTO

## VARIOUS TYPES OF BRIDGES THE WORLD OVER

1. Simple, true, broken upper-chord truss bridge over the St. Lawrence River at Lachine Rapids.
2. Cantilever bridge, at Knoxville, Tenn.
3. Hellgate Bridge, single span steel arch bridge over the East River, New York.
4. Picturesque "Flying Bridge" in Japan.

The revolving draw bridge, like the bascule, offers no hindrance to the passage of vessels, and in many cases it is the most suitable type. The total length of such spans runs up to more than 600 feet. The longest draw bridge is at Vancouver, over an arm of the bay. The "lift" bridge is one where a span of the structure is hoisted vertically, so limiting the vertical clearance for vessels. The lift spans near Bayonne, N.J., are among the heaviest of this type.

Engineers are limited, as to the size and span of a bridge, only by economic considerations. Modern steels have made it possible to construct very heavy spans up to 5000 feet. Such bridges should always be designed with due regard to aesthetics, bearing in mind that the adding of too much ornament destroys the beauty of design. *See also* BASCULE BRIDGE; CANTILEVER BRIDGE; TRUSS BRIDGE. C. E. F.

**BIBLIOGRAPHY.**—Johnson, Bryan and Turnear, *Modern Framed Structures*, 1929; M. Merriman, *American Civil Engineers' Handbook*, 1930.

**BRIDGET, ST.** (also *Brigid* or *Bride*, c. 452-523) patron saint of Kildare, was born at Foughart in Louth, Ulster, about 452. It is said that she lived in great sanctity under the branches of a huge oak tree, from which fact the city of Kildare traditionally derives its name (*Kil-dara* or the Church of the Oak). She founded the monastery at Kildare as the first religious house for women in Ireland. St. Bridget died obscurely about 523 and her day is kept on Feb. 1.

**BRIDGET OF SWEDEN, ST.** (c. 1302-72), Swedish founder of the Order of Bridgetines (*see* BRIGITTINES), was born about 1302 in Uppland, Sweden, the daughter of the governor of Uppland. She died in Rome July 23, 1373, and was canonized 20 years later. Her day is kept Oct. 8.

**BRIDGETON**, a city, port of entry, and the county seat of Cumberland Co., N.J., situated on the Cohansey River, 40 mi. south of Philadelphia. It is the trading center for a fertile truck-gardening and fruit-growing district, and also is of importance industrially, its manufactures including glass, dyed cloth, presses and dies, hampers and baskets. In 1929 the industrial output was valued at \$13,584,858, and the retail trade reached a total of \$10,028,348. Bridgeton was designated a port of entry in 1790. It received its charter as a city in 1864. Pop. 1920, 14,323; 1930, 15,699.

**BRIDGEWATER**, a town of eastern Massachusetts, in Plymouth Co., situated on the New York, New Haven & Hartford railroad, 27 mi. south of Boston. It is the seat of the State Normal School and of a large State institution for criminals. Bridgewater manufactures shoes, machinery, nails and bricks, and is a trading center for poultry and farm produce. The site of the town was purchased from an Indian chief by Miles Standish in 1649. Pop. 1920, 8,438; 1930, 9,055.

**BRIDLINGTON**, a municipal borough in the East Riding of Yorkshire, England, 31 mi. northeast of Hull. Bridlington Quay is a modern, pleasant watering place on the fine bay shore; Bridlington comprises

the ancient and picturesque market town. Here a 12th century Augustinian priory, of which only a gate remains, serving now as a town hall, is largely incorporated into the fine Church of St. Mary and St. Nicholas. Here also was an early nonconformist center where in 1662 was established a congregational society. Paul Jones captured the British man-of-war *Serapis* off Bridlington, 1778. Pop. 1921, 23,101; 1931, 19,704.

**BRIEUX, EUGÈNE** (1858- ), French dramatist, was born in Paris, Oct. 14, 1858. He was a newspaper reporter and editor, but turned to playwriting. His first play, a collaboration with Gaston Salandri, was produced in 1879. In 1890 his second, *Ménage d'Artistes*, was played at the *Théâtre libre*. Among his other successful works are *Blanchette*, 1892, *Les Trois Filles de M. Dupont*, 1897, *La Robe Rouge*, 1900, *Maternité*, 1904, *Suzette*, 1909, *Les Américains Chez Nous*, 1920. The theme of his dramas is social injustice, each one dealing with some particular fault in society. Many of them are available in translation: *Three Plays by Brieux*, with a preface by G. B. Shaw, 1911, and *Four Plays of the Free Theatre*, 1915.

**BRIG.** *See* SHIPS, TYPES OF.

**BRIGADE**, in military science, a military unit composed basically of a HEADQUARTERS and two or more regiments together with a medical detachment and combat and field trains. The total strength of an infantry brigade, officers and men, is 6,317, and, on the march, it occupies 4.8 miles of road space. The field artillery brigade of the Infantry Division consists of two regiments of 75mm. guns and one regiment of 155mm. howitzers. The cavalry brigade has an aggregate strength, officers and men, of 2,972.

In the navy, brigade generally refers to a single ship's company, but in its true meaning, it refers to the larger organization made up for use by the ships of a SQUADRON. When ships are assembled and each has a battalion organization, the formation of the brigade is quickly made.

**BIBLIOGRAPHY.**—U. S. War Department, *Tables of Organization*.

**BRIGADIER GENERAL**, a military commander, normally assigned to a BRIGADE. Equivalent duty on the staff of high commands in the supply corps or in the administrative branches of an army carries the same title. In military rank, brigadier general takes precedence over COLONEL and comes immediately below major general. (*See* GENERAL.)

**BRIGANTINE.** *See* SHIPS, TYPES OF.

**BRIGGS, CHARLES AUGUSTUS** (1841-1913), American scholar and theologian, was born in New York City, Jan. 15, 1841. He was educated at the universities of Virginia and Berlin, and at Union Theological Seminary. In 1870 he was ordained a Presbyterian minister and after serving four years as pastor at Roselle, N.J., became professor of theology at Union Theological Seminary. He helped to revise the *Hebrew and English Lexicon* and published *The Fundamental Christian Faith* and many other

religious works. Briggs died in New York City, June 8, 1913.

**BRIGHAM**, a city in northern Utah, situated near Bear River and Great Salt Lake, 60 mi. north of Salt Lake City. Bus lines and two railroads afford transportation. Brigham is the county seat of Box Elder Co. and is famous for its peaches. During the autumn Peach Day Festival the fruit is given to all visitors. Near by are a bird sanctuary and hot mineral springs. Pop. 1920, 5,282; 1930, 5,093.

**BRIGHAM YOUNG UNIVERSITY**, located at Provo, Utah, a private coeducational institution affiliated with the Church of Jesus Christ of Latter-Day Saints, was founded in 1875. The main source of income is an annual church appropriation. The library contains 65,000 volumes. In 1930 there was a student enrollment of 1,611, and a faculty of 102 headed by Pres. FRANKLIN S. HARRIS.

**BRIGHT, JOHN** (1811-89), British statesman, was born at Rochdale, Nov. 16, 1811. He left school at sixteen to enter his father's cotton mill, becoming a partner in 1839. Meeting Richard Cobden in 1835, he began his political career when he was persuaded by him to speak against the Corn Laws in 1838; he helped to organize the Anti-Corn Law League, 1839, and was the laws' most powerful opponent until their repeal in 1846. Elected to Parliament in 1843, he quickly became famous, both as a reformer and as an orator. He vainly opposed the Crimean War, but when he entered the Cabinet in 1868 he had seen success in much of his reform work, and he continued active until the end of his life. At the time of the American Civil War he supported the Union cause. He died at his home, One Ash, Mar. 27, 1889.

**BIBLIOGRAPHY.**—John Bright, *Speeches on Parliamentary Reform*, 1866, and other volumes of his public addresses; G. M. Trevelyan, *The Life of John Bright*, 1913.

**BRIGHT, RICHARD** (1789-1858), British physician, was born in Bristol, England, Sept. 28, 1789. He was the leading consultant of London in his day, and was for many years connected with Guy's Hospital. He was the first to describe inflammation of the kidney, now known as Nephritis or Bright's Disease. He was an extraordinary observer, having written down remarkable accounts of his observations of various unusual disorders. He died in London, Dec. 16, 1858.

**BRIGHTON**, a municipal and county borough and seaside resort of Sussex, England, 51 mi. south of London. Situated between a fine sea frontage and the roll of the Downs, it is the most popular and largest resort in Great Britain. The site was once Roman, and in 1086 Brighthelmston was a flourishing fishing village. But in later centuries Brighton's prosperity waned and did not receive fresh impetus until George IV as Prince of Wales became enthusiastic and built the extravagant £1,000,000 pavilion, which, during the World War, served as a hospital. It is now restored as a show-place together with the Esplanade, piers, museums, parks and other places of public amusement. The sea wall, begun in 1830, is 60 ft. high, tapering from a thickness of 23 ft. at the

base to 3 ft. at the top. Brighton was the scene of many famous escapades of Byron and others, and it is a saying that Browning was the one eminent Englishman never to visit it. In addition to its highly organized amusement catering, the town still carries on fisheries, and has motor works. Pop. 1921, 147,373; 1931, 147,427.

**BRIGHT'S DISEASE.** See NEPHRITIS.

**BRIGITTINES** (Order of St. Savior), a religious order founded by St. Bridget (Brigitta) of Sweden on her estate at Vadstena, in 1346. It admitted both men and women in double monasteries. The order flourished in northern Europe, Italy and England, but was suppressed during the Reformation; the mother-house in Sweden was dissolved in 1595. The exiles carried on their order in Lisbon for 267 years. It was introduced into Spain as Brigittines of the Recollection, and revived in England in 1861. There are now 12 Brigittine monasteries, in England, Bavaria, Holland, Rome, Spain and Mexico. The constitutions, first approved by Pope Urban V, were revised by Gregory XV in 1622.

**BRIMSTONE.** See SULPHUR.

**BRINDISI**, a city of southeastern Italy, in the province of Lecce, seat of an archbishop, and the best harbor on the west coast of the Adriatic. The citadel built by Emperor Frederick II is now a penitentiary, and there are other obsolete fortifications. The cathedral was built in 1150 by King Roger and rebuilt in 1743. An ancient settlement known as *Brundisium*, the city was a strategic point of the Saracens in the 9th century and was taken from them by Emperor Louis II in 871. It had a short period of glory during the Crusades, but waned as Venice became preeminent. The city has local industries, a radio station and an airport with service to Athens and Constantinople. Brindisi had great military importance during the World War and since then oriental steamship lines have begun to increase business. Pop. 1931, 39,658.

**BRINE COOLERS**, stationary apparatus for removing heat from the "brine" used in cooling and refrigerating systems. Of the types in general use, the "double-pipe" type consists essentially of an inner pipe through which flows the brine, and an outer, enclosing pipe through which the ammonia or other refrigerant passes in the opposite direction. The "submerged tube" type comprises a continuous tube which conducts the refrigerant through the brine in which it is immersed. Other types in general use are modifications of the two described above. See also HEAT EXCHANGE EQUIPMENT.

**BRINELL TEST**, a test made on metals to determine their "hardness." A hardened steel ball, usually 10 mm. in diameter, is forced into a flat surface of the material to be tested. The pressure used is generally 3000 kilograms. The diameter of the indentation is measured by means of a microscope and the "hardness number" is taken from an arbitrary table prepared by Brinell.

**BRINTON, DANIEL GARRISON** (1837-99), American ethnologist, was born at Thornbury, Pa.,

May 13, 1837. He was graduated from Yale in 1858 and from Jefferson Medical College in 1861. He served as a medical officer in the Union Army, and after the Civil War located in Philadelphia, Pa., where he became successively assistant editor and editor of the *Medical and Surgical Reporter*. In 1884 he was appointed professor of ethnology and archaeology in the Academy of Natural Sciences, Philadelphia, and became professor of American linguistics and archaeology at the University of Pennsylvania in 1886. Brinton's *Library of Aboriginal Literature*, in eight volumes, and *Notes of the Floridian Peninsula* are his most important works. He died at Atlantic City, N.J., July 31, 1899.

**BRIQUETTING**, the pressing of finely divided ANTHRACITE or BITUMINOUS COAL, COKE, LIGNITE, culm or other low-grade, low-priced fuels, and dusts that are unavoidable in mining and shipping, into bricks, spheres or ovoids, which can be burned efficiently. The low-grade fuel to be briquetted is first crushed to uniform fineness in jaw or roll crushers. With this a definite quantity of binder, preferably one that is combustible, such as PITCH or highly caking bituminous coal, is thoroughly mixed. The mixture is then fed into a press or through rollers containing recesses for shaping, frequently under pressures of from 3,000 to 4,000 pounds and sometimes at comparatively high temperatures. The compressed lumps or "briquettes" drop from the press or rollers onto a conveyor belt (*see* CONVEYING MACHINERY) on which they are cooled and conveyed to storage or directly to railroad cars.

Thus far, it has not, in general, been profitable to manufacture briquettes in the U.S. on account of the low prices of medium-sized, high-grade coals. Also, American bituminous mines (*see* COAL MINING) average only about one-third the depth of European mines, hence, overhead pressures are less, resulting in smaller proportions of fine sizes and dust. Throughout Europe, however, briquetting is widely employed, briquettes being particularly adaptable to use in LOCOMOTIVES and domestic fireplaces. H. W. B.

**BIBLIOGRAPHY.**—A. H. Stillman, *Briquetting*, 1923; W. E. Goodrich, *Utilization of Low Grade and Waste Fuels*, 1924.

**BRISBANE, ARTHUR** (1864- ), American journalist and editor, was born in Buffalo, N.Y., Dec. 12, 1864, and educated in the public schools and in France and Germany. At 19 he became a reporter on the *New York Sun*. He was successively editor of the *Evening Sun*, managing editor of the *New York World*, editor of the *New York Evening Journal* and owner of the *Washington Times* and *Milwaukee Evening Wisconsin*. In 1918 he became editor also of the *Chicago Herald and Examiner*. Brisbane is noted for his editorials written for the William Randolph Hearst group of newspapers.

**BRISBANE**, the capital and largest city of QUEENSLAND, Australia, situated on the Brisbane River about 20 mi. by water from its mouth in Moreton Bay. It is separated into four divisions: North Brisbane, South Brisbane, Kangaroo Point and Fortitude Valley, all

connected by fine bridges and broad streets. The population in 1929, including the suburbs, was 318,631.

Brisbane was first settled in 1825 as a penal settlement. After a period of difficulties, it was selected as the capital of Queensland when the latter became a colony in 1859. With this event the city prospered, and now has a number of industries which include the preparation of foodstuffs and clothing, and tanning, engineering, sawmilling and automobile plants. The commercial life of Brisbane is closely bound up with its river and its shipping.

Progress in the arts and education has kept pace with the development of industry. The National Art Gallery was founded in 1905, and the University of Queensland in 1909. There are two cathedrals, about 40 churches, four splendid parks and beautiful botanic gardens.

**BRISEIS**, or Hippodamia, the daughter of Briseus, a maiden taken by ACHILLES at the conquest of Lyrnessus. During the siege of TROY AGAMEMNON took her from Achilles when he was made to give up CHRYSEIS. Thereupon Achilles refused to join in the battle.

**BRISOT, JEAN PIERRE** (1754-1793), surnamed De Warville, French revolutionary leader, was born at Ouarville, France, on Jan. 14, 1754. A member of the legislative assembly and of the convention for the city of Paris, he associated himself with the Girondists group and became one of its outstanding leaders. An ardent nationalist and advocate of war, in the belief that a war against foreign powers would unite all parties in France, he contributed much to the temporary success of his party. With the triumph of the Jacobins in the Convention, however, he was arrested and guillotined with the other leaders of the Gironde on Oct. 31, 1793.

**BRISTOL**, a city and seaport of England, in the counties of Gloucester and Somerset, but also a separate county in itself, situated on the land side of the neck of the peninsula formed by the rivers Frome and Avon, 118 mi. west of London. The discovery of America turned the eyes of Europe westwards; in 1630 John Winthrop planted a colony at Charlestown, Mass., and also in Maine a colony was founded by Bristol merchants. In 1620 the *Mayflower* sailed, and by the end of the century Bristol was doing a triangular trade: sending goods to Africa, thence shipping slaves to America and returning to the home port with sugar and tobacco. The introduction of free trade and the abolition of the slave trade affected the sugar traffic very adversely, and with the advent of the steamship Bristol gradually declined commercially. The difficulty of entering the port, coupled with the heavy dock dues, diverted trade and Liverpool outstripped Bristol. In 1848 shipping revived owing to the city's purchasing the harbor, reducing the dock charges, taking over the Portishead and Avonmouth docks from private companies and building a new dock seawards to accommodate the larger ocean-going steamers. The principal industries are



tobacco mills, ship-building, sugar refineries, chocolate factories, potteries, chemical works, breweries, soap and shoe factories. Bristol was created a see and a city in 1540, with the Church of St. Augustine as cathedral. Of its other churches the most famous is the imposing St. Mary Redcliff. Pop. 1921, 377,018; 1931, 396,918.

**BRISTOL**, a city in Hartford Co., central Connecticut, situated 18 mi. southwest of Hartford. The New Haven Railroad and electric lines serve the city and there is an airport located here. Bristol is an industrial center, manufacturing iron, brass and steel products. For many years it has been famous for clock making. In 1929 the factory output amounted approximately to \$46,000,000; the retail trade reached a total of \$11,071,679. Tobacco is raised in the vicinity. The city was settled in 1727 and incorporated as a town in 1785 when it was set off from the town of Farmington. Pop. 1920, 20,620; 1930, 28,451.

**BRISTOL**, a borough in Bucks Co., southeastern Pennsylvania. It is situated on the Delaware River, opposite Burlington, N.J., and it is served by river craft and the Pennsylvania Railroad. There is an airport. Bristol is in an agricultural region. The various local manufactures include airplanes, carpets, worsted woolen products, chemicals, leather, boilers, zinc, soap and paint. In 1929 the manufactured output was worth about \$12,000,000; the retail trade reached a total of \$4,763,964. Bristol was founded about 1681, and for some years known as Buckingham. It was incorporated in 1720, re-incorporated in 1905. American troops were quartered here during the Revolution. Pop. 1920, 10,273; 1930, 11,799.

**BRISTOL**, a county seat including a village of the same name in Bristol county, southeastern Rhode Island. It is on Narragansett Bay, 18 mi. southeast of Providence and served by the New Haven Railroad and by a bridge connecting with Rhode Island. The adequate harbor, although it is of little commercial importance, is a noted yachting center. Bristol has woolen and rubber factories and large yacht building yards. Truck farming is carried on in the vicinity of the city. In 1929 the manufactured output was worth about \$18,000,000; the retail trade amounted to \$3,195,022. Bristol became a part of Plymouth Co., Mass., in 1681, and came into Rhode Island in 1747. Pop. 1920, 11,375; 1930, 11,953.

**BRISTOL**, an urban unit consisting of two adjoining cities, one in Washington Co., southwestern Virginia, and the other in Sullivan Co., Tennessee. The cities are politically independent but in other respects form one community. Bristol is situated 135 mi. southwest of Roanoke and is served by bus and truck lines and two railroads. There is an airport. Dairy products, cattle, tobacco and grain are the chief agricultural interests. The leading manufactures are paper pulp, leather, clothing, furniture and other wood products. In 1929 the factory output was worth about \$13,000,000; the retail trade amounted approximately to \$12,800,000. Timber and coal fields are at hand. Bristol is the seat of Virginia

Intermont, King and Sullins Colleges. Unaka National Forest and Smoky Mountain National Park lie in the vicinity. Bristol was founded in 1851 and incorporated in 1856. Pop. 1920, 6,729; 1930, 8,840; combined with city in Tennessee, 1920, 14,776; 1930, 20,845.

**BRISTOL CHANNEL**, the largest inlet of Great Britain. It is an arm of the Atlantic, extending between the shores of south Wales on the north and the counties of Devon and Somerset on the south, forming the estuary of Severn at its eastern end. The channel is about 80 mi. long and varies from 5 to 45 mi. in width. Chief among the rivers flowing into it are the Severn, Avon, Wye, Towy, Axe and Torridge. Tides are very high, rising 38 ft. at spring tides at Newport, 29 ft. at neap tides.

**BRISTOW, BENJAMIN HELM** (1832-96), American statesman, was born at Elkton, Ky., June 20, 1832. He graduated in 1851 at Jefferson College, Pa., and was admitted to the Kentucky bar two years later. In 1861 he joined the Union army as lieutenant-colonel, but resigned his commission in 1863 to enter the Kentucky legislature. Appointed United States Attorney for the Kentucky district, 1866, he helped rescue his state from post-war chaos. President Grant made him the first solicitor-general in 1870, and Secretary of the Treasury in 1874. In the latter capacity, he was instrumental in crushing the notorious "Whiskey Ring." Bristow resigned in 1876, and in the same year was a leading candidate for the Republican nomination for the presidency. Failing to be named he resumed the practice of law in New York, where he died June 22, 1896.

**BRISTOW, GEORGE FREDERICK** (1825-98), American composer, violinist and teacher, was born Dec. 19, 1825, in Brooklyn, N.Y., the son of an English organist. In 1845 he became a violinist in the New York Philharmonic Society, which two years later played his *Concert Overture*. He gained national attention with the production, in 1855, of his three-act opera, *Rip Van Winkle*. Bristow did pioneer work in the movement for music in America by Americans, and opposed the growing vogue for music by German and Italian composers. His orchestral works include four symphonies, among them *Niagara*, and two oratorios. He died at New York City, Dec. 13, 1898.

**BRISTOW**, a city in Creek Co. in eastern Oklahoma, situated about 40 mi. southwest of Tulsa. The Frisco Railroad and bus lines serve the city. There is an airport located on the outskirts of the city. Bristow is a trade market for cotton which is the chief crop of the region. The city also is a manufacturing center producing tools, cotton, and cotton seed products. Oil fields lie in this district. Bristow was founded and incorporated in 1898. Pop. 1920, 3,460; 1930, 6,619.

**BRITAIN**, a name of Celtic origin representing the anglicized form of *Britannia*, the classical appellation for the island now including England, Scotland and Wales. In pre-Roman times Britain was inhabited



by Celtic tribes who had entered Britain during the Bronze Age and again during the Iron Age, bringing with them, apparently from the western continent, a well-developed social and religious culture. Their priests were the druids who, in their functions of physician, diviner and historian, dominated the daily life of the people. Julius Caesar's incursions into Britain in 55 and 54 B.C. brought the natives into a definite relationship with the Roman world. Under the Emperor Claudius in 43 A.D. the Romans landed in Britain and south Britain was finally brought under control after the suppression of the revolt in 61 A.D. under the native warrior queen, Boadicea. Vespasian in 78 A.D. ordered a fresh advance, and Agricola in the next decade succeeded in extending Roman rule beyond the Humber River. In 121 A.D. the emperor Hadrian had the famous Roman Wall built between the Solway Firth and the Tyne River as a defensible frontier and safeguard against the attacks of the northern Picts. In the 3rd century A.D. Severus attempted in vain to make a permanent conquest of the Pictish tribes of the North. During the 4th century Rome's power steadily declined, and finally mutinies among the Roman troops in Gaul and the invasion of Italy by the Visigoths under Alaric forced the Roman emperors to gradually withdraw their troops from the island. The emperor Honorius decreed the final abandonment of Britain in 410 A.D. *See ENGLAND, HISTORY OF.*

**BRITANNIA METAL**, an alloy of tin and antimony, copper sometimes being added. The better grades comprise 90 parts tin and 10 parts antimony, while the lower grades consist of 94 parts tin, 5 parts antimony and 1 part copper. It is used in spoons, tea pots, and other tableware.

**BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, THE**, was founded in 1831 "to give a stronger impulse and more systematic direction to scientific inquiry, to obtain a greater degree of national attention to the objects of science and to promote the intercourse of the cultivators of science with one another." The association is divided into 17 sections, covering the different departments of science, and holds annual conventions for reading of specially prepared papers and general conferences. In addition to these meetings, which are open only to members, the association provides lectures by outstanding scientists for the public. Grants are made to individuals and organizations for setting on foot new movements in scientific investigation and for furthering scientific research. In 1930 a Centennial Fund was started to increase these grants.

**BRITISH COLONIAL EMPIRE, THE DEPENDENT.** The grant of responsible government to the more advanced British colonies, which began during the decade 1840-50, was the beginning of an evolutionary process which has given rise to the present distinction between the **BRITISH COMMONWEALTH OF NATIONS** and the dependent British Colonial Empire. The latter is a far-flung and heterogeneous aggregate of communities and includes territories in each

of the continents. Its area, exclusive of the Anglo-Egyptian Sudan, which is under the British Foreign Office, and exclusive also of certain dependencies which are administered by Dominion Governments, is approximately 2,000,000 square miles, or about 40 times the size of England. Its population in 1932 was only a little over 50,000,000; but its soil is prevailingly fertile, and with improved methods of agriculture it could support a much larger population. Most of the territories of which it consists are situated in the tropics, and the advances in tropical sanitation and medicine, to which the colonial Governments are giving increasing attention, will no doubt result in a decline in the death rate, especially in the African dependencies.

Parts of the dependent Empire have long been under British rule. Some of the West Indian colonies were settled more than 300 years ago. Gibraltar was conquered during the WAR OF THE SPANISH SUCCESSION, over 200 years ago. But by far the larger part of the Colonial Empire, both in area and in population, has come under British rule during the period since about 1880. This is true, in particular, of the dependencies in West and East Africa, which contain nearly three-fourths of the total area and nearly seven-tenths of the total population of the dependent Empire. In its present form, therefore, this Empire is rather new, and it has aroused much less popular interest than either the British Commonwealth of Nations or the Indian Empire, the other two constituents of the wider British Empire. But those who are conversant with its resources and possibilities believe that it has a great future, and its history, political, social and cultural, is full of interest.

**Geographic Groups.** Geographically, the dependencies may be divided into the following groups: (1) The West Indian and Atlantic group includes the British West Indian Islands, the mainland colonies of British Guiana and British Honduras, Bermuda and the Falkland Islands. The West Indies were once esteemed the brightest jewels in the British diadem, but they suffered economic decline in the 19th century, mainly owing to vicissitudes in the sugar industry. There are indications, however, that more prosperous days are in store for them. The subject of a West Indian federation has been under discussion for several years, and a consultative West Indies Conference has been instituted for the purpose of considering and making recommendations regarding matters of public importance to the constituent colonies. Its first meeting, attended by representatives of the Governments of the West Indian colonies, British Guiana, British Honduras and Bermuda, was held in Barbados in Jan. 1929. (2) The Mediterranean and Near East group comprises Malta, Gibraltar, Cyprus, Palestine and Transjordan. Malta, home of a highly civilized people with an active national sentiment, and of imperial importance on account of the great naval base at Valletta, has a peculiar Constitutional status. Under a Constitution established in 1921 a distinction is made for purposes of government between imperial and internal affairs. With respect to the former, the

governor, who is subordinate of course to the Colonial Office, may legislate by ordinance and the Crown may legislate by order in council. As regards internal affairs Malta possesses a responsible Government, with a ministry responsible to the local legislature. (3) The Far East group includes Mauritius, Ceylon, British Malaya and Hong Kong. Ceylon, with its palm groves and plantations of tea, rubber and coconuts, a land of fertile hills and luxuriant valleys and ancient Buddhist temples, is the most beautiful country in the Colonial Empire. Hong Kong is one of the world's great commercial seaports. (4) The Pacific Islands group includes Fiji and the protectorates that have been attached to it. (5) The Tropical African dependencies are divided into a West African and an East African group. The former consists of four detached blocks of territory, Gambia, Sierra Leone, Gold Coast and Nigeria, geographically separated and surrounded for the most part by French possessions. Their total population is about 23,000,000. Climatic conditions make it impossible for the European to establish himself as a permanent settler in West Africa. Agriculture is necessarily left to native enterprise and management, and it has been found expedient, especially in Nigeria, to leave the work of government largely to native authorities, under British supervision. In southwestern Nigeria there are 10 native cities of more than 40,000 inhabitants each, and one of them, Ibadan, has a population of nearly a quarter of a million. British East Africa stretches from Abyssinia and the Sudan on the north to the Zambesi River on the south and comprises approximately one-half of the entire area of the Colonial Empire, though its population is only about 12,000,000. The five dependencies of which it consists are Kenya, Uganda, Tanganyika, Nyasaland and Northern Rhodesia. They lie wholly in the tropics; but the greater part of their territory, unlike that of West Africa, is at high altitudes, and in some parts, notably in the highlands of Kenya, the normal elevation exceeds 5,000 feet. This means that permanent European settlement is possible, and there are some 20,000 European settlers in East Africa. The problem caused by the conflicting interests of the whites and the natives has engaged the attention of British statesmanship.

**British Colonies.** The constituent parts of the Colonial Empire do not all bear the same designation. Some of them are colonies, others are protectorates, and still others are mandated territories. A colony, unlike a protectorate or a mandated territory, is strictly and in law a possession of the British Crown. In each colony there is a governor, who represents the king and is assisted by an executive council. But this council is not a cabinet, such as exists in Great Britain and in the Dominions; it is not responsible to the local legislature, and the governor is not under Constitutional obligation to act upon its advice. The colonial governor, unlike the governor general of a Dominion, really governs, subject to instructions from the Secretary of State for the Colonies, who is a member of the British Cabinet. All but a

very few of the colonies have legislatures; but these are by no means uniform in constitution. In a large majority of the colonies there are single-chamber legislatures, of which the governor is always a member. In most cases some of the members of these legislative councils, as they are called, are elected, but in what may be called the typical Crown colony there is an appointed official majority or, to put it in another way, the executive dominates the legislature. In some of the colonies, where the population includes two or more distinct cultural communities, there is a system of communal representation, whereby each community elects a certain number of representatives. In Ceylon a constitution of a novel type, experimental in character, was inaugurated in 1931. Committees chosen by the legislature, most of whose members are elected on a wide franchise which is extended to women, decide questions affecting the departments assigned to them, and the governor normally acts upon their advice, though he may disregard it in cases of necessity. He has reserved powers of legislation, and in emergency he may assume control of any department.

**British Protectorates.** The protectorates, strictly speaking, are not part of the king's dominions, and their inhabitants are not British subjects. The legal idea underlying the concept of the protectorate is the exercise of British jurisdiction in foreign territory, and at first protectorates were regarded as foreign countries within which Great Britain had by treaty acquired certain political rights and powers. But they have been placed under the jurisdiction of the Colonial Office and are governed as if they were colonies. In the official classification of the British dependencies the protectorates are not grouped by themselves but appear with the colonies under the caption "Colonies in which the administration is carried on by public officers under the control of the Secretary of State for the Colonies, and Protectorates similarly controlled."

**Mandated Territories.** The mandated territory, as an entity in the Colonial Empire, is a result of the World War and is based on Article 22 of the Covenant of the League of Nations. For the territories ceded by Germany and Turkey mandates, approved by the Council of the League, were assigned by the Supreme Council of the Allied Powers. In the distribution of these mandates, Palestine, Transjordan and Iraq (previously under Turkish rule), the former German East Africa, henceforth known as Tanganyika Territory, and parts of the former German colonies in West Africa were assigned to Great Britain and passed under the administrative control of the Colonial Office. The former German possessions in South West Africa, New Guinea and Samoa were assigned to the Dominions of South Africa, Australia and New Zealand, respectively, and for these the British Government assumed no responsibility. The Tanganyika mandate authorized the mandatory "to constitute the territory into a customs, fiscal and administrative union or federation with the

adjacent territories," and the subject of a closer union of the East African dependencies has been under consideration for some years. The Palestine mandate contained provisions looking to the establishment of a Jewish National Home, in accordance with a Declaration made by the British Government during the war. The antagonism between the Arabs, who constitute an overwhelming majority of the population, and the Jews made it inexpedient to put into effect a Constitution framed by the mandatory in 1922, and the British High Commissioner, with the aid of an advisory council still legislates for Palestine. A mandate was drafted for Iraq; but public opinion among the Arab inhabitants, who were vehemently opposed to accepting the status of a mandated territory, made it inadvisable and practically impossible to put it into operation. A treaty between Great Britain and the Kingdom of Iraq, which had been established after the war, contained provisions for carrying out the intent of the mandate which were acceptable to Arab sentiment and to the League of Nations. Under present arrangements Iraq is to become a member of the League in 1932, though a treaty of alliance will guarantee to Great Britain certain rights in the country.

The different parts of the Colonial Empire differ markedly in natural and social conditions, racial composition and stage of civilization, and no uniform system of government would suit them all. But despite wide diversity there are certain elements of unity. The Colonial Empire is in the main a tropical empire; it is inhabited by non-white communities, and many of its parts present common problems, problems of agriculture, transport, native education and sanitation. A growing sense of community of interest among those responsible for its government led to a new departure of great significance when, in 1927, a Colonial Office Conference was held in London, attended by representatives of the Colonial Office and governors or other representatives of the Governments of most of the dependencies. Many subjects were discussed, upon some of which important resolutions were adopted, and the opinion was expressed that a permanent new institution had come into existence, with a future of great usefulness. A second Colonial Office Conference was held in 1930. R. L. Sc.

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**BRITISH COLUMBIA**, the most westerly province of Canada, comprising all the Pacific seaboard belonging to the Dominion of Canada, together with many coast islands, including VANCOUVER and QUEEN CHARLOTTE ISLANDS, and an extensive inland territory, all lying between 49° and 60° N. lat. It is bounded on the north by the Yukon and the Northwest Territories, on the south by the United States and the Strait of Juan de Fuca, on the east by Alberta, and on the west by southern Alaska and the Pacific Ocean.

British Columbia covers an area of 355,855 sq. mi., and is shaped like an irregular quadrangle 760 mi. long, with an average width of about 400 mi.

**Surface Features.** Four main ranges cross this mountain province from south to north: the Island and Coast ranges on the west, the SELKIRKS and ROCKIES on the east. The Selkirk Range includes the Purcell, Selkirk, Gold and the Caribou mountains. A great valley extends northwards along the western base of the Rockies for 700 mi., and a plateau with an elevation of 3,000 ft. above sea level lies east of the Coast Range. This interior plateau is eroded in some parts and appears to be a succession of mountains; in other sections are wide plains suitable for farming.

**Climate.** The summers are warm on Vancouver Island and the Pacific Coast, and frosts in winter are rare. On the higher levels of the interior the winters are colder, the summers warm, and heavy rainfall occurs in autumn and winter. Winters are moderate in the northern portion of the province. The mild climate is due mainly to the warm Japanese current which flows southerly along the coast and exerts a moderating influence. The westerly winds of the Pacific liberate most of their moisture before crossing the high, cold peaks of the Coast mountains.

**Forests, Rivers and Lakes.** The great age and size attained by the trees found in British Columbia have made the forests famous. The Douglas fir, the western hemlock, red cedar, Sitka or silver spruce, larch and pine are the principal trees. The Douglas fir averages 150 to 225 ft. in height, with a diameter of 3 to 6 ft. Many growing trees are known to be over 500 years old. The wood of this tree is unexcelled in clearness, strength and beauty. The hemlock's wood is suitable for the manufacture of pulp and paper and the bark is rich in tannic acid. Lumber in British Columbia is estimated at 360,000,000,000 cu. ft., about half the volume of the Dominion. The lake and river system of the province covers an area of 2,439 sq. mi. The principal rivers are the FRASER, STIKINE and the Skeena, all of which flow into the Pacific; the PEACE and the Liard into the MACKENZIE River system. The COLUMBIA rises in British Columbia and travels for 600 mi. before entering Washington. The lake system is extensive and important, furnishing convenient transportation facilities in the interior. Some of the principal lakes are Atlin, 211,000 acres in area; Babine, 196,000; Chilco, 109,700; Kootenay, 141,120; Upper Arrow, 64,500; Lower Arrow, 40,960; Okanagan, 86,240; Shuswap, 79,150; Harrison, 78,400. Water power is practically unlimited and is so widely distributed that no portion of the province need be without cheap motive power for driving machinery.

**National Parks.** The Dominion government has set apart four national parks, the Yoho, Glacier, Kootenay and Mt. Revelstoke, in order that the province may possess recreational resources equal to those in Alpine Europe. See separate articles on each of these parks.

**Furs and Fisheries.** The principal fur-bearing animals are the beaver, otter, lynx, marten, muskrat, wolverine, bear and mountain lion. Fur-trading was the first activity of the white man in British Columbia. The most important catches are salmon, halibut, flounder, herring, sole, cod, skate, sturgeon and pilchards for fish oil production. The catch of whales off the coast of British Columbia averages 300 to 400 yearly. Altogether, a great revenue is derived from the sea. Salmon is the most important, although excessive exploitation has depleted the Fraser River fisheries. Prince Rupert is the center of a valuable halibut industry. Deep-sea trawling is increasing each year. Many canneries dot the coast line.

**Agriculture.** The whole of the province south of 52° and east of the Coast Range is a grazing country up to 3,500 ft. elevation, and a farming country up to 2,500 ft., where irrigation is possible. The southern part of the province is an immense fruit-growing region. The great interior plateau of the central district has rapidly developed as an agricultural district. Mixed and dairy farming are carried on in the Bulkley Valley; a potato yield of 600 bu. an acre is known in this open, undulating meadow. The Caribou District is a stock country with an abundance of rich grasses. Stock-raising and grain-growing are becoming increasingly important in the great areas of the northeast, the Peace River district.

PRINCIPAL FIELD CROPS, BRITISH COLUMBIA  
1930 and Five-Year Average 1925-1929

Crop	Area	Yield Per Acre	Total Yield	Total Value
	acres	bu.	bu.	\$
Wheat ..... 1930	61,000	21.7	1,321,000	1,126,000
Av. .... 1925-29	55,117	24.5	1,348,400	1,791,200
Oats ..... 1930	91,000	46.1	4,195,000	1,888,000
Av. .... 1925-29	85,183	44.7	3,804,800	2,491,800
		cwt.	cwt.	
Potatoes ..... 1930	18,000	96.1	1,730,000	2,595,000
Av. .... 1925-29	17,819	101.5	1,808,600	3,004,200
Turnips ..... 1930	7,000	176.0	1,233,000	1,356,000
Av. .... 1925-29	6,989	201.5	1,408,400	1,393,000
		tons	tons	
Hay and clover .... 1930	183,000	1.82	333,000	5,828,000
Av. .... 1925-29	170,753	2.12	361,600	6,045,200
Grain hay ..... 1930	48,000	2.00	96,000	1,344,000
Av. .... 1925-29	57,858	2.26	130,600	1,812,800
Alfalfa ..... 1930	31,000	2.64	82,000	1,597,000
Av. .... 1925-29	23,871	2.85	68,000	1,207,000

**Fruit-Growing.** The rich valleys and lowlands offer favorable facilities for fruit-growing. Apples of excellent quality are exported in large quantities to English and other markets, and peaches, apricots, nectarines and vines are successfully raised. The sheltered valley of the Okanagan District is noted for the large production of apples and small fruit. The Kootenay Valley is famous for its stone fruit.

**Mining.** The province has great mineral wealth. The yearly output for 1929 exceeded \$70,000,000. In value of output the chief minerals were copper, lead, coal, zinc, silver and gold. In 1929 British Columbia, the leading copper-producing province of the Do-

minion, mined copper to the value of \$18,650,210. The geological conditions are particularly favorable for the formation of large copper deposits. The Coast Range batholith of Jurassic age with which most of the deposits so far known are associated, stretches from the south of the province far into the Yukon, so that there is a very large area favorably situated with respect to its intrusions. The principal coal fields of British Columbia are in five districts, known as southern interior, central interior, northern interior, Vancouver Island and Queen Charlotte Islands.

The discovery of gold first brought a rush of settlers to the southern part of the province in 1856 but the deposits then discovered were worked out. Since 1895, however, gold, silver, copper, lead and zinc mining have all been carried on in the extreme south along and near the route of the southern branch of the Canadian Pacific Railway. The chief mining district is the Trail Creek division of West Kootenay. The oldest coal mines of the province are those of Nanaimo.

**Manufactures.** The principal manufacturing industries center round the natural resources. The bulk of the production is from lumber; saw mills and pulp and paper factories have increased considerably since the World War. Shipbuilding, coke production, meat packing, fish curing and packing are important activities.

MINERAL PRODUCTION, BRITISH COLUMBIA, 1929

Item	Production	Value \$	Rank Among Provinces
Cadmium ..... lb.	773,976	675,294	1
Copper ..... "	103,903,738	18,772,778	1
Gold ..... oz.	154,204	3,187,680	2
Lead ..... lb.	307,999,153	15,555,189	1
Silver ..... oz.	10,156,408	5,382,185	1
Zinc ..... lb.	172,096,841	9,270,857	1
Coal ..... tons	2,490,378	10,160,789	3
Clay products .....	.....	866,427	4
Cement ..... bbl.	680,907	1,487,223	5
Lime ..... tons	39,591	510,592	3
Sand and gravel ..	2,425,996	665,132	4
Stone ..... "	408,931	511,655	4
Other products .....	.....	1,117,077	—
Total all products ...	.....	68,162,878	2

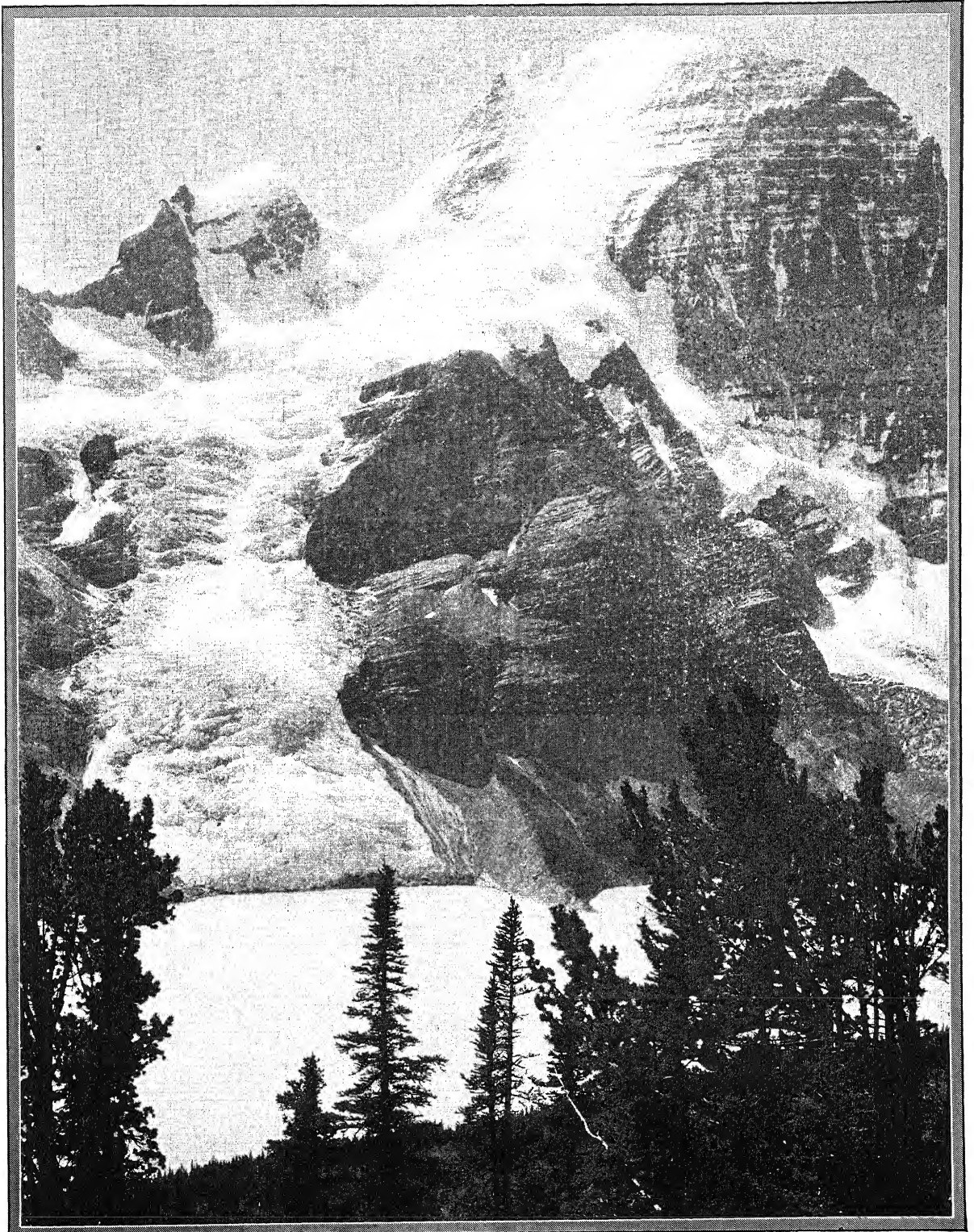
**Transportation.** The Canadian National and the Canadian Pacific railroads extend widely throughout the province, and branches of the Great Northern Railroad link up with many parts of the United States. Ships from Vancouver reach the Atlantic through the Panama Canal; fleets of liners ply to and from Japan, China and Australasia and coastal vessels operate to Alaska, Seattle and San Francisco.

**Education.** Free education is provided by an act of 1872. The school age is from 7 to 15. Common, graded and high schools are maintained by the provincial government. A university at Vancouver, at one time one of the colleges of McGill University, became the Provincial University in 1908.

**Population.** In 1921 the population, consisting chiefly of Canadians, British, or settlers from the



## BRITISH COLUMBIA



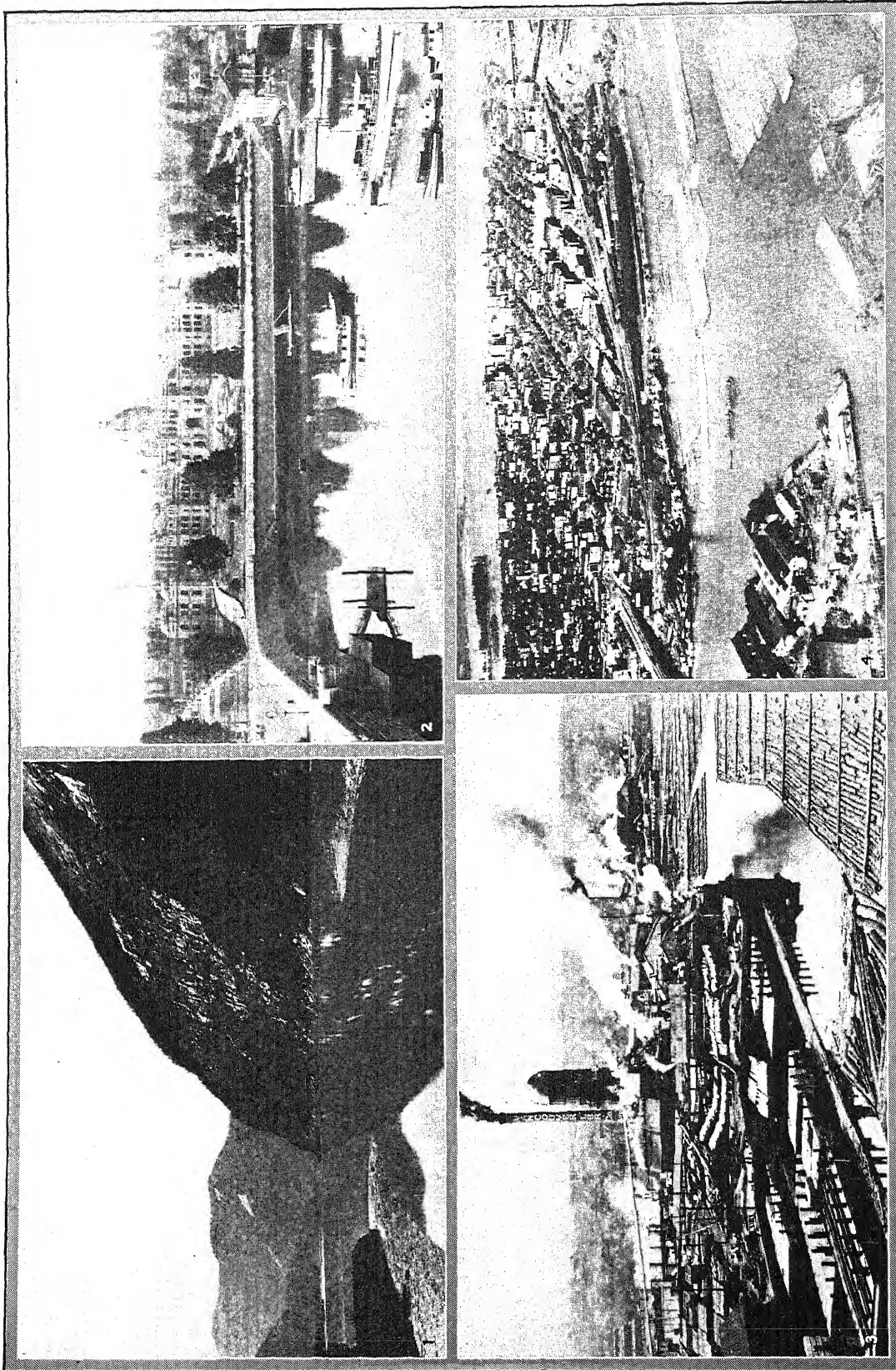
COURTESY CANADIAN NATIONAL RAILWAYS

### MOUNT ROBSON IN BRITISH COLUMBIA

Rising to a height of 12,972 ft., Mount Robson is the highest peak of the Canadian Rockies. At the foot of its impenetrable slopes lies Berg Lake, whose icy cold waters are fed solely by the glaciers of the mountains surrounding it.



# BRITISH COLUMBIA



1. 2. 4. COURTESY CANADIAN NATIONAL RAILWAYS: 3. CANADIAN PACIFIC RAILWAYS

## BRITISH COLUMBIA, THE GREAT WESTERN PROVINCE OF CANADA

1. Along the Pacific Coast near Prince Rupert.
2. Provincial Parliament Building at Victoria, from the inner basin of the city's harbor.
3. Modern sawmill at Vancouver. Miles of uncut forests are the province's most valuable resource.
4. Air view of Vancouver, one of the largest cities of Canada.

# ALBERTA

Ar. 255,285 sq. m.  
Pop. .... 731,605

## PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)

Pop.—Thousands

3 Banff... N 19  
2 Blairmore... P 20  
84 Calgary... N 20  
2 Camrose... K 21  
2 Cardston... K 21  
1 Claresholm... P 21  
2 Coleman... P 20  
3 Drumheller... N 22  
79 Edmonton... K 20  
1 Ft. Saskatchewan... J 21  
1 Grande Prairie... I 16

1 Hanna... M 22  
1 High River... O 21  
1 Innisfail... M 20  
1 Lacombe... L 21  
13 Lethbridge... P 22  
1 Macleod... P 21  
1 Magrath... P 22  
10 Medicine Hat... O 24  
1 Olds... M 20  
1 Pincher Cr... P 21  
2 Raymond... P 22  
1 Red Cliff... O 24  
1 Red Deer... M 20  
1 Stettler... L 21  
1 Taber... P 22  
2 Vegreville... K 22  
1 Vermilion... K 23  
1 Wainwright... K 23  
2 Wetaskiwin... K 21

Pop.—Hundreds

7 Brooks... O 22  
8 Canmore... N 19  
7 Coronation... M 23  
8 Didsbury... M 20  
7 Gleichen... N 21  
9 Leduc... K 20  
8 Mundare... K 21  
8 Okotoks... O 21  
9 Peace River... G 17  
8 Ponoka... L 21  
8 St. Albert... K 20  
9 St. Paul... J 22  
8 Vulcan... O 21

## BRITISH COLUMBIA

Area 355,855 sq. m.  
Pop. .... 694,263

## PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)

Pop.—Thousands

1 Armstrong... O 16  
2 Chilliwack... O 13  
1 Courtenay... Q 11  
3 Cranbrook... Q 19  
2 Cumberland... Q 11  
2 Duncan... Q 12  
3 Fernie... Q 20  
1 Grand Forks... Q 17

6 Kamloops... O 15  
1 Kelowna... P 16  
1 Ladysmith... Q 12  
1 Merritt... P 15  
1 Mission... Q 13  
7 Nanaimo... Q 12  
6 Nelson... Q 18  
18 New Westminster... Q 13  
9 North Vancouver... Q 12  
2 Port Alberni... Q 11

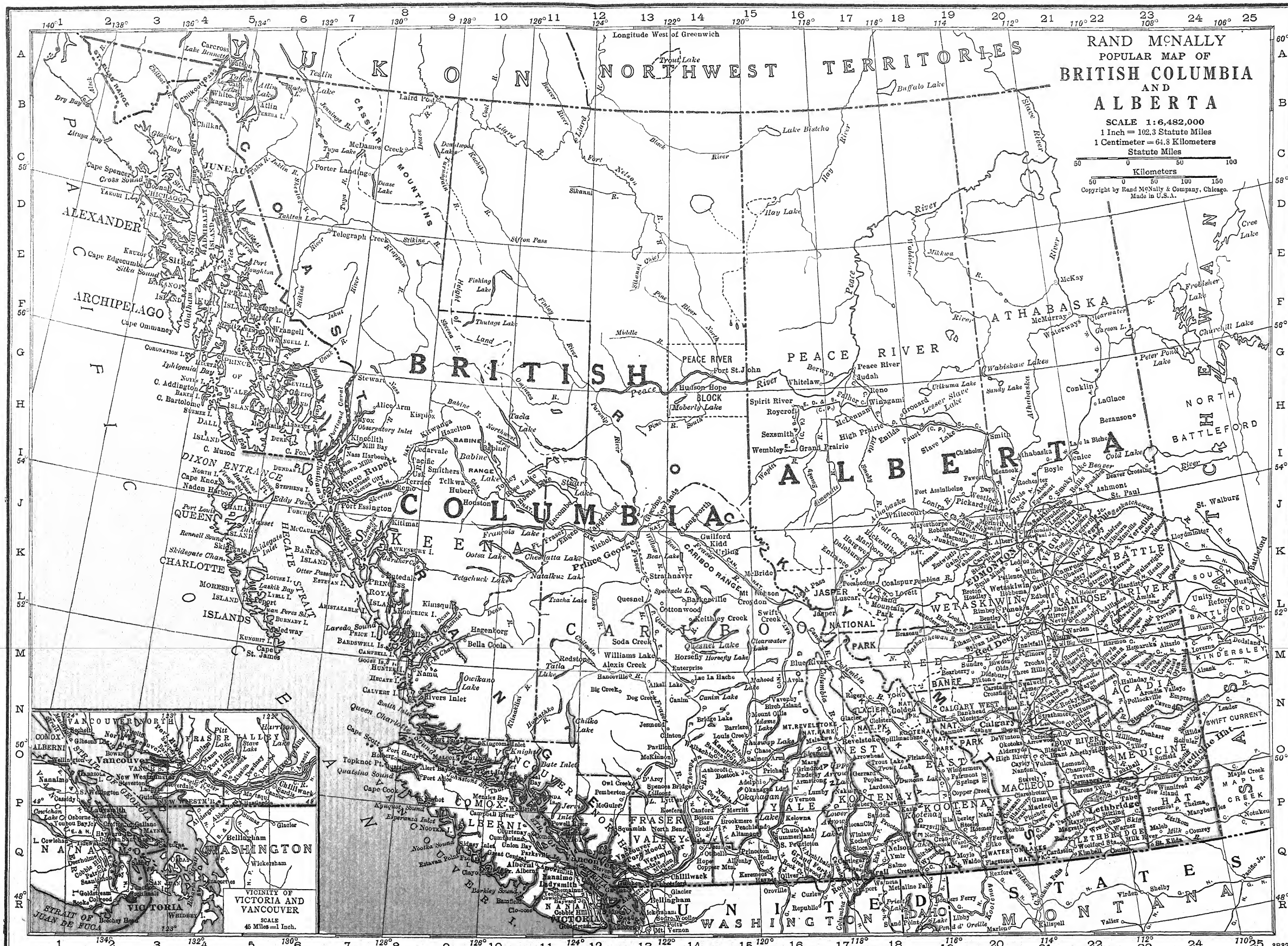
1 Port Moody... O 2  
2 Prince George... K 13  
6 Prince Rupert... J 17

3 Revelstoke... J 7  
3 Rossland... Q 17  
1 Smithers... I 9  
8 Trail... Q 18  
245 Vancouver... Q 12

4 Vernon... P 16  
39 Victoria... R 12

Pop.—Hundreds

8 Michel... P 20  
8 Peachland... P 15



RAND McNALLY  
POPULAR MAP OF  
BRITISH COLUMBIA  
AND  
ALBERTA

SCALE 1:6,482,000  
1 Inch = 102.3 Statute Miles  
1 Centimeter = 64.8 Kilometers  
Statute Miles

50 100 150  
Kilometers

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United States, numbered 524,582; in 1931, 694,263. There were also about 50,000 Orientals and Indians. The principal cities and towns are Victoria, the capital, and Nanaimo, both situated on Vancouver Island; across the straits on the mainland are Vancouver, the largest city, New Westminster, Prince Rupert and Nelson.

**History.** In 1792 Capt. George Vancouver reached the coast of British Columbia and encircled the island to which he gave his name. The territory was known as New Caledonia. The interior was partly explored by Alexander Mackenzie and the North-West Company, which in 1821 amalgamated with the Hudson's Bay Company. In 1792 the ship *Columbia*, of Boston, sailed into the river upon which the commander, Capt. Grey, bestowed the name of his vessel, and which afterwards gave the name to the province. The mainland of British Columbia remained a wilderness with two or three trading posts of the Hudson's Bay Company till 1858 when gold prospectors discovered the rich diggings of the Fraser River. The influx of people was so great that the region was erected into a Crown colony in the same year, under the name of British Columbia, a title decided upon by Queen Victoria. In 1866 Vancouver, which had become a colony in 1849, was united to British Columbia, which in 1871 was declared a province of Canada.

**BRITISH COLUMBIA, UNIVERSITY OF**, at Vancouver, B.C., Canada, a coeducational and non-sectarian institution, incorporated in 1908. Laboratories are available for all courses, and there is a library containing 72,000 volumes. In 1930 there was an enrollment of 2,904 students, and a faculty of 169 headed by Pres. LEONARD S. KLINCK.

**BRITISH COMMONWEALTH OF NATIONS, THE**, is one of the three constituent parts of the British Empire, the other two being the Indian Empire and the dependent BRITISH COLONIAL EMPIRE. The term British Commonwealth, which came into vogue during the World War, is sometimes employed as a synonym of British Empire, but the better usage confines it to the self-governing parts of the Empire. The British Commonwealth, in this sense, consists of the United Kingdom of Great Britain and Northern Ireland, the senior partner of the Commonwealth; the Irish Free State, separated from the United Kingdom in 1922 and since then under a Dominion form of government, and the oversea British Dominions, namely, the Dominion of Canada, the Commonwealth of Australia, New Zealand, the Union of South Africa and the self-governing colony of Newfoundland. The total white population of the Commonwealth is approximately 70,000,000, of whom 45,000,000 reside in the United Kingdom.

**System of Responsible Government.** The widely scattered communities of this aggregation vary greatly in area, population, economic resources and political organization, and each has its own characteristics and problems. But they exhibit important similarities. In the first place, the territories which they inhabit are situated in the temperate zones, the

only exceptions being the northern part of Canada, which lies in the Arctic and is incapable of supporting any considerable population, and the northern part of Australia, which lies in the Tropics. Secondly, they are, with the exception of the Union of South Africa, white communities, and even in South Africa the whites, though in a minority, are politically dominant. Thirdly, they all possess, and this distinguishes them politically from the other parts of the Empire, the system of Responsible Government which grew up in England in the 18th century, was extended to the British North American colonies about the middle of the 19th century, and afterwards to the Australasian and South African colonies. In all of these self-governing colonies, or Dominions, as they have been officially styled since 1907, the administration of public affairs is conducted by ministers who are responsible to the local legislature, and the governor general occupies a position similar to that of the king in the United Kingdom. Under present Constitutional practice, as defined by the Imperial Conference of 1930, he is appointed by the king upon the advice of the Government of the Dominion concerned.

The increasing autonomy of the Dominions, which has resulted in their present status of Constitutional equality with the United Kingdom, is without parallel in history. Nearly 100 years ago Lord Durham, in his celebrated *Report on the Affairs of British North America*, 1839, recommended the introduction in the British colonies in North America of the system of Responsible Government, though he specified certain subjects which, in his opinion, ought to be reserved for imperial control, notably external trade, foreign relations and the making of colonial Constitutions. But Responsible Government for colonies, as Durham conceived it, proved to be unstable. The sphere of colonial control tended to expand and the sphere of imperial control to contract correspondingly. By 1914 the Dominions had become self-governing in virtually all their internal affairs and had acquired control over certain branches of their external affairs, including foreign trade and immigration; but in the realm of foreign affairs, including diplomatic relations, treaty-making and control over the issues of war and peace, they were still dependencies. It had become obvious that they stood in a different relation to the Imperial Government from that borne by the dependent colonies, and as early as 1907 a department was established in the British Colonial Office in charge of business connected with the Dominions. The contrast between Dominions and dependencies was emphasized by the course of events during the World War and the post-war period, and in 1925 a new Dominions Office was set up, with a Secretary of State for Dominion Affairs at its head, which took over from the Colonial Office all business relating to the Dominions and to the Imperial Conferences. Since then the Colonial Office has been concerned only with the dependencies.

During the years between the Durham Report and the outbreak of the World War, when the content of

Countries	Capital	Population *	Area (Square Miles)	Imports (Dollars)	Exports (Dollars)
GREAT BRITAIN AND NOR. IRELAND . . . .	London and Belfast	45,741,000	94,633	5,936,930,000	4,078,983,000
EUROPE:					
Irish Free State . . . . .	Dublin	2,943,000	27,000	296,927,000	187,463,000
Gibraltar . . . . .	Gibraltar	15,600	2	.. . . .	.. . . .
Malta . . . . .	Valletta	232,800	122	19,644,000	2,848,000
ASIA:					
Aden, Perim and Prot. . . . .	Aden	50,809	9,000	34,623,000	26,083,000
Bahrain Islands . . . . .	Manama	120,000	250	9,225,000	5,419,000
Borneo, Brunei and Sarawak . . . . .	Sandakan	1,000,000	77,106	17,730,000	44,022,000
Ceylon . . . . .	Colombo	5,479,000	25,332	139,093,000	131,988,000
Cyprus . . . . .	Nicosia	347,959	3,584	9,642,000	7,950,000
Hong Kong . . . . .	Victoria	1,075,700	391	660,960,000	729,000,000
India . . . . .	Delhi	351,450,689	1,805,332	1,060,233,000	1,182,108,000
Straits Settlements . . . . .	Singapore	1,134,200	1,600	499,623,000	524,725,000
Fed. Malay States . . . . .	Singapore	1,660,900	27,648	113,996,000	197,476,000
Other Malay States . . . . .	.. . . .	1,459,900	23,486	38,214,000	84,452,000
Palestine . . . . .	Jerusalem	946,000	9,000	34,832,000	7,552,000
AFRICA:					
Kenya Colony and Prot. . . . .	Nairobi	2,992,000	212,000	43,356,000	34,122,000
Uganda Prot. . . . .	Entebbe	3,410,900	110,300	.. . . .	.. . . .
Zanzibar . . . . .	Zanzibar	216,800	1,020	8,087,000	8,369,000
Mauritius and Dep. . . . .	Port Louis	416,000	809	15,008,000	16,995,000
Nyasaland Prot. . . . .	Zomba	1,360,000	37,890	3,747,000	3,038,000
St. Helena and Ascension . . . . .	Jamestown	4,100	81	228,000	190,000
Seychelles . . . . .	Victoria	27,600	156	1,030,000	1,215,000
Somaliland Prot. . . . .	Berbera	345,000	68,000	2,299,000	1,162,000
Basutoland . . . . .	Maseru	498,800	11,716	3,431,000	3,378,000
Bechuanaland Prot. . . . .	Mafeking (Cape)	73,600	275,000	.. . . .	.. . . .
Southern Rhodesia . . . . .	Salisbury	1,058,000	149,000	43,079,000	41,976,000
Northern Rhodesia . . . . .	Livingstone	1,308,600	288,000	17,506,000	4,374,000
Swaziland . . . . .	Mbabane	122,800	6,704	.. . . .	.. . . .
Union of South Africa . . . . .	Pretoria	7,894,600	472,347	406,562,000	424,137,000
Nigeria . . . . .	Lagos	19,264,000	335,700	65,143,000	87,116,000
Gambia . . . . .	Bathurst	240,000	4,134	3,003,000	4,107,000
Gold Coast and Prot. . . . .	Accra	3,121,000	80,000	48,999,000	61,615,000
Sierra Leone and Prot. . . . .	Freetown	1,541,300	31,000	8,695,000	7,446,000
Anglo-Egyptian Sudan . . . . .	Khartum	5,605,900	1,014,000	34,151,000	32,509,000
Tanganyika Terr. . . . .	Dar-es-Salaam	4,800,000	365,000	20,830,000	19,382,000
Southwest Africa . . . . .	Windhoek	259,000	332,400	14,979,000	17,472,000
Cameroon . . . . .	Buea	700,000	31,000	1,045,000	1,497,000
Togoland . . . . .	.. . . .	188,000	12,600	.. . . .	.. . . .
AMERICA:					
Bermudas . . . . .	Hamilton	27,789	19	8,349,000	904,000
Canada . . . . .	Ottawa	10,374,196	3,729,665	1,263,877,000	1,134,256,000
Falkland Islands . . . . .	Port Stanley	3,378	5,618	3,830,000	21,549,000
British Guiana . . . . .	Georgetown	309,700	89,480	10,770,000	12,427,000
British Honduras . . . . .	Belize	51,200	8,598	5,054,000	4,875,000
Newfoundland . . . . .	St. John's	270,600	162,734	29,602,000	37,257,000
Bahamas . . . . .	Nassau	59,828	4,404	9,545,000	700,000
Barbados . . . . .	Bridgetown	170,400	166	9,904,000	6,225,000
Jamaica, etc. . . . .	Kingston	1,022,152	4,431	34,151,000	22,380,000
Leeward Islands . . . . .	St. John's	126,500	715	4,073,000	4,374,000
Trinidad . . . . .	Port of Spain	377,500	1,974	27,187,000	34,613,000
Windward Islands . . . . .	St. George's	163,000	516	4,024,000	3,732,000
AUSTRALASIA:					
Australian Commonwealth . . . . .	Melbourne	6,414,400	2,974,581	685,911,000	606,766,000
Papua . . . . .	Port Moresby	276,500	90,540	1,818,000	1,580,000
New Zealand . . . . .	Wellington	1,419,000	104,751	209,106,000	218,413,000
Fiji . . . . .	Suva	180,000	7,083	7,139,000	8,631,000
Pacific Islands . . . . .	Suva, Fiji	265,000	11,450	.. . . .	.. . . .
Terr. of New Guinea . . . . .	Rabaul	458,000	89,252	4,267,000	4,845,000
Western Samoa . . . . .	Apia	45,000	1,250	1,405,000	1,429,000

\* Based on the latest statistics available May 1, 1932.



## DOMINIONS, COLONIES, PROTECTORATES, MANDATES

Political Character	Executive Authority	Accession to the Empire		Countries
		Method	Date	
Rep. in Parliament	King and Ministry	Conquest and Political Union	449-1283	GREAT BRITAIN AND NOR. IRELAND
Free State	Gov.-General	Conquest, Treaty	1494-1922	EUROPE:
Crown Colony	Governor	Treaty, Cession	1713	Irish Free State
Colony	"	"	1814	Gibraltar
				Malta
Colony and Protectorate	Political Resident	Cession, Settlement, Protectorate	1839-1876	ASIA:
Protectorate	"	Protectorate	1867	Aden, Perim and Prot.
Colony and Protectorate	Gov., Agt. and Com's'r.	Cession, Protectorate	1881-1888	Bahrain Islands
Crown Colony	Governor	Treaty, Cession	1796-1815	Borneo, Brunei and Sarawak
Colony	"	Annexation	1914	Ceylon
Crown Colony	"	Treaty, Cession	1842	Cyprus
Viceroyalty	Gov.-Gen. in Council	Conquest, Cession	1612	Hong Kong
Crown Colony	Governor	Treaty, Cession	1785-1909	India
Protectorate	High Com's'r.	"	1874-1888	Straits Settlements
"	Sultan; Adviser	"	1885-1914	Fed. Malay States
Mandate	High Commissioner	Conquest, Mandate	1914-1918	Other Malay States
				Palestine
Colony and Protectorate	Governor	Annexation	1920	AFRICA:
Protectorate	"	Occupation	1894	Kenya Colony and Prot.
"	High Commissioner	Treaty, Cession	1890	Uganda Prot.
Colony	Governor	Conquest, Cession	1810-1814	Zanzibar
Protectorate	"	Treaty, Cession	1891	Mauritius and Dep.
Colony and Naval Station	Gov. and Commandant	Conquest, Occupation	1673 and 1815	Nyassaland Prot.
Colony	Governor	Treaty, Cession	1794	St. Helena and Ascension
Protectorate	"	"	1884	Seychelles
Territory	Resident Com's'r.	Conquest	1884	Somaliland Prot.
Protectorate	"	"	1885-1895	Basutoland
Colony	Governor	"	1889	Bechuanaland Prot.
"	"	"	"	Southern Rhodesia
Protectorate	Resident Com's'r.	Treaty	1894	Northern Rhodesia
Legislative Union	Gov.-General	Conquest, Treaty	1814-1910	Swaziland
Colony and Protectorate	Governor	Settlement, Purchase	1861-1900	Union of South Africa
" " "	"	Treaty, Cession	1807	Nigeria
" " "	"	"	1672	Gambia
" " "	"	"	1787	Gold Coast and Prot.
Protectorate	Gov.-General	Conquest	1899	Sierra Leone and Prot.
Territory	Governor	"	1918	Anglo-Egyptian Sudan
Mandate	Administrator	"	1920	Tanganyika Terr.
"	Gov. of Nigeria	Conquest, Annexation	1916	Southwest Africa
Colony	Gov. of Gold Coast	Conquest	1914	Cameroon
				Togoland
Colony	Governor	Settlement	1612	AMERICA:
Dominion	Gov.-General	Settlement, Conquest	1627-1763	Bermudas
Crown Colony	Governor	Treaty, Cession	1771	Canada
Colony	"	Conquest, Cession	1803-1814	Falkland Islands
Crown Colony	"	Conquest	1798	British Guiana
Dominion	"	Treaty, Cession	1713-1904	British Honduras
Colony	"	Settlement	1629	Newfoundland
"	"	"	1625	Bahamas
"	"	Conquest	1655-1670	Barbados
"	"	Settlement	1623-1659	Jamaica, etc.
"	"	Conquest	1797	Leeward Islands
"	Gov. and Administrators	Cession	1763-1783	Trinidad
				Windward Islands
Commonwealth	Gov.-General	Settlement	1788-1828	AUSTRALASIA:
Territory	Lt. Governor	Annexation	1884	Australian Commonwealth
Dominion	Gov.-General	Settlement, Treaty	1840	Papua
Crown Colony	Governor	Cession	1874	New Zealand
.....	High Commissioner	Cession, Conquest	1893-1915	Fiji
Territory	Administrator	Mandate	1920	Pacific Islands
"	"	Treaty	1919	Terr. of New Guinea
				Western Samoa

colonial self-government was being enlarged, a marked change took place in the point of view from which colonies were regarded in England. From about 1850-70, when the free trade and *laissez-faire* doctrines of the Manchester School were in the ascendant, the prevailing view among British statesmen and officials was that the separation of the colonies from the mother country was inevitable, and that British policy should recognize this. About 1870 a reaction against this view set in, and during the next 20 years there was much discussion of closer union with the colonies. The Imperial Federation League, which was founded in London in 1884 and lasted till 1893, failed to bring about a Constitutional reorganization of the Empire on Federal lines, but it stimulated interest in imperial questions, and it was at the instance of the League that the British Government summoned a Colonial Conference in 1887, thus bringing into existence the institution, now known as the Imperial Conference, which was to become the central consultative organ of the British Commonwealth. After about 1890 the ideal of imperial federation tended to fall into the background, though it was revived to some extent by the Round Table movement in the years immediately preceding the World War and gained some impetus during the war. The progress of events in the Empire was not in the direction of federation, which was essentially a British conception, but rather toward the Dominion ideal of a voluntary partnership or alliance between the United Kingdom and the Dominions. The military participation of Canada, Australia and New Zealand in the South African War, 1899-1902, anticipated the later and far greater cooperation of the Dominions with the United Kingdom in the World War, and the tariff preferences which the Dominions accord to British imports, which began with the Canadian preference of 1897, are on a purely voluntary basis. At the Colonial Conference of 1907 it was agreed that in future Conferences the representatives of the Dominions should meet with those of the United Kingdom on a footing of equality, the Prime Minister of the United Kingdom presiding, but only as "first among equals."

**Changes Wrought by World War.** The important part played by the Dominions in the World War led to increasing dissatisfaction with the remaining limitations upon their complete self-determination, and the Imperial War Conference of 1917 adopted a resolution, presented by Sir Robert Borden, Prime Minister of Canada, which expressed the view that Constitutional relations within the Empire should be readjusted as soon as possible after the war, and that such readjustment, "while thoroughly preserving all existing powers of self-government and complete control of domestic affairs, should be based upon a full recognition of the Dominions as autonomous nations of an Imperial Commonwealth" and should recognize the right of the Dominions to "an adequate voice in foreign policy and in foreign relations, and should provide effective arrangements for continuous consultation in all important matters of common Im-

perial concern, and for such necessary concerted action, founded on consultation, as the several Governments may determine." This resolution was generally regarded as putting a negative on any solution of inter-imperial relations along the line of federation. The Dominions secured separate membership in the Peace Conference of 1919, participated as distinct political entities in the signature and ratification of the Peace Treaty, and, with the exception of Newfoundland, became members of the League of Nations. The Irish Free State which came into existence in 1922, with the Constitutional status of a Dominion, was admitted to the League in 1923.

The right of the Dominions to establish diplomatic relations with foreign countries was recognized by the British Government in 1920, when announcement was made that a Canadian Minister to the United States would be appointed by the King on the recommendation of the Canadian Government. Canada, the Irish Free State and the Union of South Africa, but not Australia or New Zealand, now have legations in a number of foreign countries.

The question of the procedure to be followed in Dominion treaty-making was considered in detail at the Imperial Conferences of 1923 and 1926. The right of a Dominion to make treaties with foreign states, provided that obligations were not thereby imposed upon other parts of the Empire, was fully recognized, though it was agreed that no Government of the Empire ought to make any treaty without due consideration of its effects on other parts of the Empire. Authority to negotiate and sign Dominion treaties is given by the king on the advice of the Government concerned; but this advice, technically speaking, is conveyed to the king by a British minister, and the formal instruments of "full powers" and ratification are issued under the great seal of the United Kingdom. In 1931 the Irish Free State, dissatisfied with this procedure, announced that in the future the Government of the Free State would tender advice directly to the king and that a new seal, to be kept in Ireland, would be used on all documents relating to Free State treaties on which the great seal had previously been used. This decision, it has been said by a recognized authority on the Constitutional law of the Dominions, "marks the most decisive step yet taken towards the termination of the diplomatic unity of the Empire."

In the years immediately following the war statesmen in Great Britain, as well as in the Dominions, publicly asserted that equality of status was the cornerstone of the new British Commonwealth; but in some of the Dominions, notably South Africa and the Irish Free State, there was a strong desire for a more formal declaration of equality. Such a declaration was made when the Imperial Conference of 1926 approved the Report of its Inter-Imperial Relations Committee, of which Lord Balfour was chairman, in which it was declared that the United Kingdom and the Dominions were "autonomous communities within the British Empire, equal in status,

in no way subordinate one to another in any aspect of their domestic or external affairs, though united by a common allegiance to the Crown, and freely associated as members of the British Commonwealth of Nations." Equality of status, common allegiance and free association were thus affirmed to be the basic principles underlying the Constitutional relations between the members of the Commonwealth.

But acceptance of these principles did not automatically solve all the problems of the Commonwealth. There were certain legal forms and practices, survivals of an earlier stage in Constitutional evolution, which were not in accord with the principle of equality, such as the legal rule that any act of the Parliament of a Dominion was invalid if it was repugnant to any act of the Parliament of the United Kingdom applying to the Dominion; and these the Imperial Conference could not alter, since it had no legislative authority. It recommended, accordingly, that a number of questions involved in giving full effect to the principle of equality of status should be referred to experts for examination. A special Conference on the Operation of Dominion Legislation and Merchant Shipping Legislation, representative of the United Kingdom and the Dominions, was held for this purpose in 1929. It recommended that the Parliament of the United Kingdom should pass a comprehensive statute to remove the remaining limitations upon full Dominion self-government and drafted a number of clauses to be included in the proposed statute. The Imperial Conference of 1930 approved these recommendations, with one or two modifications, and they were incorporated in what is known as the Statute of Westminster, passed in 1931, which removes, or makes it possible for the Dominions to remove, the last vestiges of Dominion dependence upon the United Kingdom.

R. L. Sc.

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**BRITISH DRAMA, MODERN.** See **ENGLISH DRAMA, MODERN.**

**BRITISH GUIANA**, or **DEMERARA**, a colony on the northeast coast of South America, between 1° and 8° N. lat. and 57° and 61° W. long. It has an Atlantic coast line of about 270 mi., and is bounded on the south and southeast by Brazil, on the east by Dutch Guiana and on the northwest by Venezuela. Area 89,480 sq. mi. The colony may be divided broadly into three belts: the northern one is a low-lying, flat and swampy strip of marine alluvium known as the coastal region; it is succeeded by a broader and slightly elevated tract of country composed of sandy and clayey soils; the more elevated portion lies to the southward of these regions and contains a mountainous area consisting of undulating plateaus rising from 1,200 to 2,000 ft. and cut in places into deep gorges of which the Kaieteur is pre-

eminent for its size and beauty; the culminating point is reached in the flat-topped Roraima and Kukenam which rise 5,000 ft. above the surrounding country and 8,600 ft. above the sea.

The population in 1931 was 310,933; 95% of these are Negroes and Asiatics, or mixed races. There is a considerable group of Portuguese, and about 4,000 others of European stock. In the hot and sultry climate the Asiatics are lacking in physical stamina. Tropical maladies are common, for there is a widespread apathy in regard to sanitary conditions.

The forests cover 77,780 sq. mi., or about 87% of the total area of the colony. These tropical forests comprise a great variety of species and form mixed forests. In places one or more species predominate, and such areas are locally known by the name of the prevailing tree such as Crabwood, Mora, Greenheart, Wallaba or Dakama Forest. Many beautiful orchids and mosses are found in the swamp areas. Balata is the leading forest product. The trees in the forests bear nuts and fruits to feed monkeys, rodents, bats and fishes, and because these are present in large numbers the cat family is well represented. Sugar cane, 51,000 acres, occupies more than one-third of the cultivated land in the colony. The sugar by-products, rum and molasses, are valuable. Rice, well-adapted to the physical conditions of the coastal savannas, holds an important place in the British Guianan export movement. Coconut trees grow on more than 30,000 acres, and flourish and bear prodigiously on sandy coastal soils.

Diamonds form more than one-fourth of the colony's exports; they are by far the second, next to sugar, commercial commodity. Situated in an almost inaccessible district, the Mazaruni diamond fields rank next to those of Africa. GEORGETOWN, the capital and chief port, ships about 180,000 carats yearly, valued at more than \$3,500,000. Bauxite and gold are lucrative fields for exploitation in the colony.

**History.** In 1617 SIR WALTER RALEIGH had led an expedition to Guiana in search of gold, but made no settlements. In 1634 the British established the colony of Surinam, but no active national policy was taken toward the Guianan lands until the rule of Cromwell and the beginning of an active West Indies trade. But not until the next century, when all Europe was engaged in an orgy of colonization, did England occupy any considerable part of Guiana. They acquired what is now British Guiana in 1781, only to be driven out the following year. In 1796 the Dutch, preferring that England be the colonial mistress rather than France, surrendered the territory to the British as well as many other rich possessions. By the TREATY OF AMIENS in 1802 England restored Guiana to the Dutch, but regained it in the Congress of Vienna in 1814-15. It was divided into three provinces, Demerara, Essequibo and Berbice, and rapidly became the most prosperous of the sugar colonies. In the development of the sugar-making industry steam power and modern machinery were introduced by the planters.

In 1895 the boundary dispute with Venezuela, which had been in progress for nearly 100 years, became an international question. The United States' demand for arbitration of the dispute resulted in a favorable decision for British Guiana in 1899 by an international commission. In 1904 the king of Italy, acting as international arbiter, decided in Great Britain's favor in her boundary dispute with Brazil.

**BRITISH HONDURAS**, a British crown colony, situated on the Caribbean Sea, south of the Mexican province of Yucatan and 700 mi. west of Jamaica; on the west is Guatemala. Area, 8,598 sq. mi. Pop. 1931, 51,347.

A few miles from the coast marshes and swamps occur covered by heavy vegetation and dotted by numerous lagoons. The southern part of the colony is largely occupied by the rugged Cockscorn Mountains. The prevailing formations are granites, hard limestones and schists which, owing to their vertical disposition, are difficult to scale. The culminating point, Mount Victoria, although only 3,700 ft. high, is seldom climbed.

The vegetation varies with the temperature and covers a wide range of tropical and subtropical plants. Maize, rice, bananas, pineapples, oranges, coffee, cacao, cotton, cassava, rubber, mangoes and cocoanuts grow freely and easily. The flowers of the colony are superb in coloring and fragrance and are of great variety. Mahogany, ironwood and other hard wood trees occur. Much of the coastal mahogany forests is exhausted, but extensive tracts in the interior still abound in this valuable timber. Large areas of secondary forest or bush occur, of different ages; of these the trumpet tree is a common inhabitant. Forests throughout the Maya area, including British Honduras, are not primeval, but represent natural reforestation over a previously cleared area.

The principal products of the colony are tropical fruits, mahogany, logwood, chicle and cedar. An important discovery of tin has been made in several places in the Stann Creek district.

There are six languages spoken in the colony: English, Spanish, North Maya, South Maya, Keekchi and Carib. The climate of the colony is healthy. The average mean temperature is about 79° F., with annual rainfall averaging about 70 in.

British Honduras was formally called Belize. The old name, Belize, is the English form of the Spanish *Balixa*, a corruption of Wallace, name of the British freebooter who first gained a footing there early in the 18th century. The capital, situated on the coast, is now called BELIZE. Although driven out more than once, the settlers always returned, and at last secured territorial rights.

**History.** The earliest European settlers at Honduras Bay were Englishmen who arrived in 1638, abandoning the profession of piracy for that of logwood cutting. Later arrivals exploited the pearl fisheries. The settlers frequently raided the logwood establishments of the Spaniards, inviting retaliatory expeditions, the most formidable of which was a force

of 1,500 men organized at Peten in 1754, who were utterly routed by the British muster of 250 men. In 1763 Spain recognized the rights of the British logwood cutters; but, provoked by smuggling and other alleged offenses, an expedition was dispatched from Yucatan which in 1779 destroyed the settlement of Belize, and removed the prisoners to Havana. The survivors were liberated in 1782, and returned to Honduras Bay with new adventurers enlisted in Jamaica. In the Treaty of Paris, 1783, Spain acknowledged the courses of the Belize River and the Rio Hondo as the boundaries of the British settlement, and in 1786 made an additional grant of the area between the Belize and Sibun rivers. As a corollary of the war in Europe, in 1798 a Spanish expedition of 2,000 men embarked from Campeachy in 13 ships for Belize; the settlers, aided by one British sloop of war, repulsed the attack. This attempt to dislodge the British was the last; but the Spanish claim to ultimate sovereignty remained formally undisputed, and as late as 1819 acts of the British Parliament referred to Belize as "a settlement, for certain purposes, under the protection of His Majesty." When the Central-American provinces overthrew the Spanish rule, the British Government entered into treaties with the newly created republics which guaranteed the entity of the Honduras Bay settlement. Boundary disputes with Guatemala were adjusted by 1859, when British Honduras attained its present limits. Its progress has been orderly and uneventful.

**BRITISH ISLES**, two large islands, GREAT BRITAIN (England, Scotland and Wales) and IRELAND, and over 5,000 small islands with a total area of 121,633 sq. mi., and a population in 1931 of about 48,000,000. The islands lie in the northwest of Europe, between 50° and 60° N. lat. and are divided from the mainland, France, by the Strait of Dover, about 20 mi. wide at its narrowest breadth.

After the coast of the Mediterranean had been fully explored, colonies of Greeks were established at favorable points. About 330 B.C., Pytheas, a Greek colonist of Marseilles, sailed out into the ocean and explored its shore northward, discovering the British Isles.

Although there are now no lofty mountain chains or great rivers in the islands, there is much variety of land formation and scenery, the result of remote geological changes and of the more recent action or erosion upon the different kinds of rocks which form the surface. In Scotland and Ireland the rocks are similar in character to those of the Scandinavian Peninsula. It is estimated that in comparatively recent or post-Miocene times the highest peaks of the islands were about 3,000 ft. higher above sea level than they are now. The character of the surface has an intimate relation to the variety of coast line. A belt of hard old rock in the west, overlooking the Atlantic from a considerable height and carved by glaciation and exposure into angular fiord-like coasts, the islands slope down to an expanse of soft young rock in the east, which disappears gradually under





BRITISH ISLES  
DIVISIONS  
ENGLAND  
AND WALES  
Area 58,340 sq. m.  
Pop. .... 39,947,931

IRISH FREE STATE  
Area 26,592 sq. m.  
Pop. .... 2,957,000

Northern Ireland  
Area 5,237 sq. m.  
Pop. .... 1,256,561

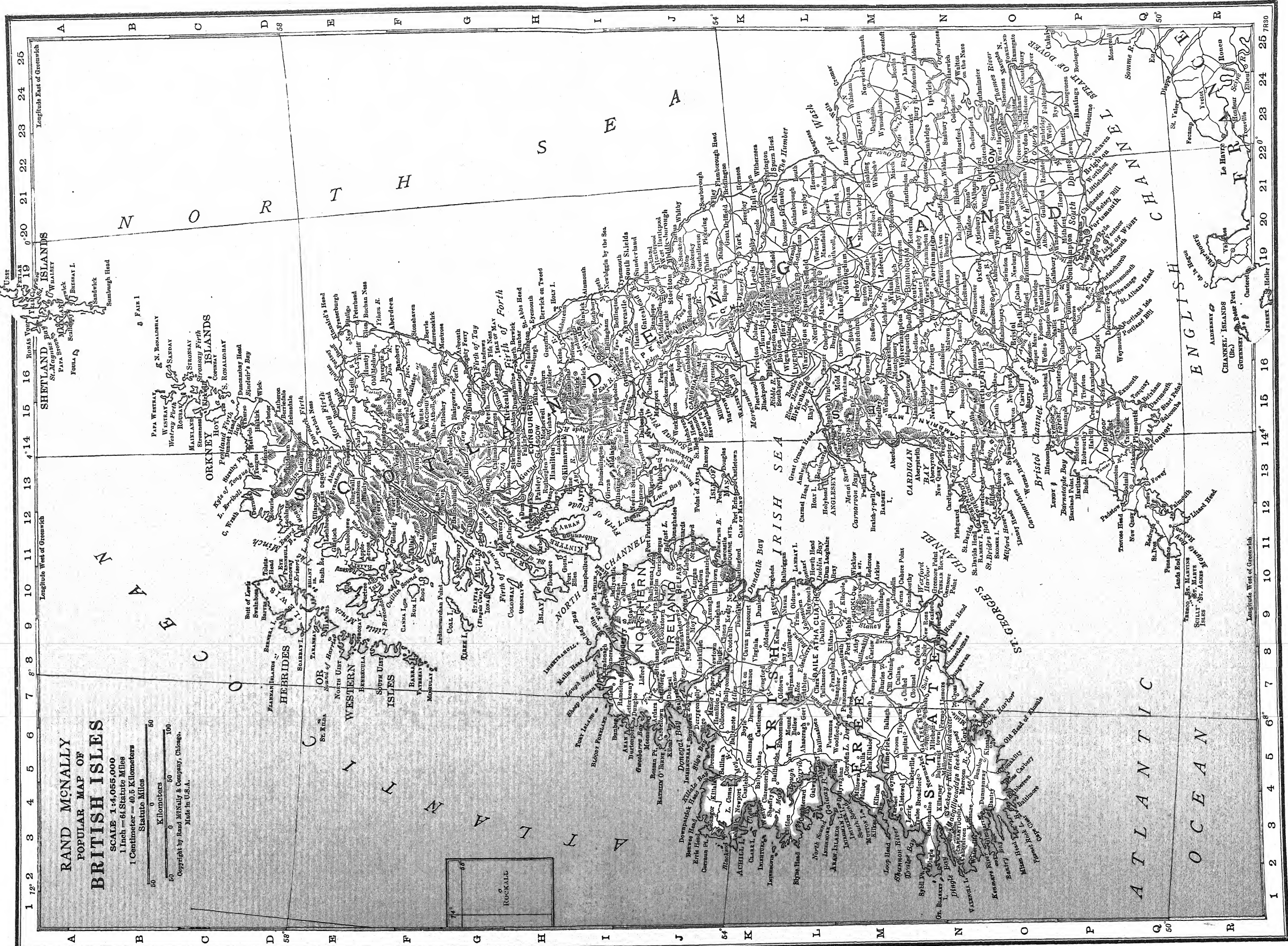
SCOTLAND  
Area 30,405 sq. m.  
Pop. .... 4,842,554

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)

Pop.—Thousands

- 167 Aberdeen, F 17
- 412 Baile Atha Cliath (Dublin), L 10
- 415 Belfast, J 10
- 148 Birkenhead, M 16
- 1002 Birmingham, M 16
- 125 Blackburn, K 16
- 102 Blackpool, K 16
- 177 Bolton, L 16
- 85 Bootle, L 16
- 117 Bournemouth, P 18
- 298 Bradford, K 18
- 147 Brighton, P 22
- 397 Bristol, O 17
- 98 Burnley, K 17
- 224 Cardiff, O 16
- 78 Cork, N 6
- 167 Coventry, N 18
- 233 Croydon, O 23
- 142 Derby, M 19
- 82 Devonport, Q 14
- 176 Dundee, G 13
- 439 Edinburgh, H 15
- 1088 Glasgow, H 15
- 53 Gloucester, N 17
- 90 Govan, H 13
- 79 Greenock, H 13
- 92 Great Grimsby, K 21
- 101 Greenwich, O 23
- 98 Halifax, K 18
- 113 Huddersfield, K 18
- 313 Hull, K 18
- 88 Ipswich, N 24
- 483 Leeds, K 18
- 239 Leicester, M 19
- 80 Leith, H 15
- 856 Liverpool, L 16
- 4397 London, O 21
- 69 Luton, N 21
- 766 Manchester, L 17
- 138 Middlesbrough, J 19
- 283 Newcastle, I 19
- 89 Newport, O 16
- 92 Northampton, N 20
- 126 Norwich, M 24
- 269 Nottingham, N 20
- 140 Oldham, M 17
- 81 Oxford, N 19
- 120 Paisley, H 13
- 208 Plymouth, Q 14
- 249 Portsmouth, P 20
- 119 Preston, K 16
- 97 Reading, O 20
- 90 Rochdale, K 18
- 512 Sheffield, L 19
- 176 Southampton, P 18
- 120 Southend, O 23
- 79 Southport, K 16
- 113 S. Shields, L 18
- 126 Stockport, L 17
- 277 Stoke, M 17
- 186 Sunderland, L 18
- 165 Swansea, O 14
- 158 Tottenham, O 22
- 103 Walsall, M 18
- 79 Warrington, L 17
- 294 Westham, O 22
- 85 Wigan, L 16
- 184 Willesden, O 21
- 133 Wolverhampton, M 17
- 85 York, K 19





shallow and narrow seas. Through this eastern coast, with its smooth and rounded outline, many rivers from the western heights carry out immense quantities of silt. In structure and relief, therefore, the islands show great variety without undue complexity, the variety being emphasized by the small area. They epitomize the geology of the world and yet continue the simple feature lines of Europe.

**BRITISH MUSEUM**, a national depository devoted to the collection of exhibits pertaining to science, literature, and art. It is situated in the Bloomsbury district of London. The institution had its origin in the Cottonian Library, containing state papers, biblical and other historical manuscripts collected by Sir Robert Bruce Cotton (1571-1631) and given to the nation in 1702. In 1753 the library was augmented by the Sloane and Harleian collections, and in 1772 Parliament obtained title to Sir William Hamilton's collection, which numbered valuable antiquities. In 1759 the government housed the growing number of manuscripts and exhibits in Montagu House, on the site of which the central portion of the present structure was built, during 1823-55. Wings were added to provide space for the steady flow of exhibits which included a generous number of the important discoveries of archæologists in the 19th century.

The original part of the present structure is built in a square, hollow at the center, with a façade fronted by an Ionic colonnade of 44 columns on the south which faces Great Russell Street. The circular reading room was built inside the square in 1854-57. The White Building on the southeast side was added in 1884, and the commodious addition on the north side, with a colonnaded façade facing Montagu Place, known as the King Edward VII galleries, was erected in 1914. The British Museum was planned originally as a depository for manuscripts and natural history objects, but the growing number of gifts and purchases forced the trustees to increase the chief departments to eight. These divisions are as follows: 1. Printed books, charts, maps, plans; 2. manuscripts; 3. natural history objects; 4. oriental antiquities; 5. Greek and Roman antiquities; 6. coins and medals; 7. British and medieval antiquities and ethnography; 8. prints and drawings. The natural history department was moved in 1881 to South Kensington Museum to provide additional space for manuscripts in the original building. Among other valuable manuscripts the museum possesses the *Codex Alexandrianus* of the Greek Bible and the *Lindisfarne Gospels* of 700 A.D. The collection of antiquities includes the Elgin Marbles and the Nereid Monument. The celebrated Rosetta Stone is in the extensive Egyptian collection. In 1930 the royal commission on national museums recommended the reconstruction of floors and roofs of the original building to lessen the fire risk and increase the structural safety of certain galleries.

**BRITISH NORTH AMERICA ACT**, a statute "for the Union of Canada, Nova Scotia, and New

Brunswick, and the Government thereof," passed by the British Parliament, Mar. 29, 1867; the authorization of the Dominion of Canada. The resolutions of the QUEBEC CONVENTION were used as the basis of the act by a Canadian delegation, including Macdonald, Cartier, Galt, Tupper and Tilley, meeting in London. Because of the refusal of Prince Edward Island to ratify the Quebec resolutions, only Quebec, Ontario, New Brunswick and Nova Scotia were included in the Confederation. The act, in 11 sections, provided the framework of the present Dominion Government; carefully defined the legislative powers of the Parliament of Canada, listing 29 specific matters; listed 16 exclusive powers of the provincial legislatures, including "generally all matters of a merely local or private nature in the Province," and set limitations upon the exclusive power of the provincial legislatures to legislate in relation to education ("nothing in any such law shall prejudicially affect any right or privilege with respect to denominational schools which any class of persons have by law in the Province at the Union"); gave the Dominion Parliament power to make provisions for the uniformity of laws relating to property and civil rights in all provinces except Quebec, and power to legislate for agriculture and immigration in any or all of the provinces; created a Consolidated Revenue Fund, carefully defined the division of revenues and liability for the public debts; provided for official parity of the English and French languages; authorized the INTERCOLONIAL RAILWAY, and defined means for the admission of new colonies into the Dominion. Subsequent British North America Acts, 1871, 1886, 1907 and 1915, respectively provided further for the establishment of Provinces in the Dominion; provided for the representation of Territories in the Dominion Parliament; fixed a schedule for yearly grants by the Dominion to each Province for local purposes; and altered the composition of the Senate.

**BRITISH NORTH BORNEO.** See BORNEO.

**BRITISH SOMALILAND.** See SOMALILAND PROTECTORATE.

**BRITISH THERMAL UNIT**, or B.t.u., the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. It is used chiefly by engineers. One B.t.u. is equal to 252 small CALORIES, or 0.252 kilogram calories.

**BRITISH WEST INDIES.** See ANTILLES.

**BRITTAIN, MARION LUTHER** (1865- ), American educator, was born in Wilkes County, Ga., Nov. 11, 1865. He was graduated from Emory College, 1886, and studied at the University of Chicago. He taught in schools at Atlanta, Ga., 1888-99; was superintendent of schools in Fulton County, Ga., 1900-10, and state superintendent of schools, 1911-22. In 1922 he was chosen president of the Georgia School of Technology. His publications include *Introduction to Caesar and Blue Book of Stories*.

**BRITTANY**, an ancient duchy and province of northwestern France, a peninsula bordering on the English Channel, corresponding to the departments

of Finistère, Côtes-du-Nord, Morbihan, Ille-et-Vilaine and Loire-Inférieure. It has an area of 18,630 sq. mi. This Armorican peninsula has its special characteristics; separated from Normandy and Maine by a belt of forest, which was for long a deserted border, Brittany for many years lived apart from French life. Repeopled in the 6th century by emigrants from the island of Britain, it retained its Celtic language along with certain traits of character. This language, called Breton, is closely allied to Welsh and is still spoken locally in the western part. In spite of the slight elevation, the province possesses great variety of scenery owing to the diversity of the rocks, which have been carved by erosion. Because of the seaweed manure, the whole coast has been extensively cultivated, especially in the north, where the fertility of soil under a climate of extreme mildness assures the early ripening of vegetables, the object of an important trade. Many of the inhabitants are fishermen. The coast of Brittany is remarkable for its dense population.

**History.** Being geographically isolated from the rest of France the Armorican peninsula preserved its local independence longer and its local peculiarities more persistently than did the other provinces. In the sixth century Celtic emigrants from Britain, fleeing from the Saxons, settled here and the Celtic language still prevails. Early Breton history is confused and obscure. By the 11th century, however, the duchy tended to fall under the suzerainty of the dukes of Normandy. The marriage of Geoffrey Plantagenet, son of Henry II of England, to the Breton heiress brought the duchy into the Plan-



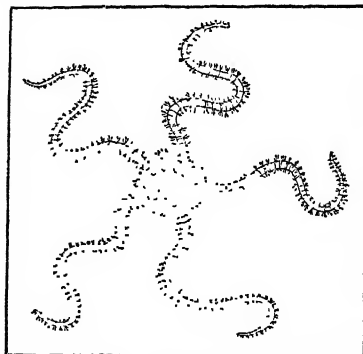
FROM AMER. MUS. OF NATL. HISTORY

DOLMEN (DE MANÉ-KERIONED À CARNAC) IN CARNAC, BRITTANY

tagenet empire. Philip Augustus' victory over King John of England enabled him to give Brittany to Pierre de Dreux, a relative of the Capetian house. A disputed succession in the 14th century became entangled in the Hundred Years War, victory going to Montfort, the English protégé, in consequence of the battle of Aurai. During the next century by playing off the French and English the dukes preserved their feudal independence, but the dismemberment of the Burgundian state after 1477 left the French king free to devote his attention to Brittany. Unable to resist the French armies the heiress, Anne of Brittany, married Charles VIII in 1491, an event which completed the territorial unity of France and concluded the independent history of Brittany.

**BRITTLE STAR**, an echinoderm of the class *Ophiuroidea* or snake tails, found only in salt water.

Under this name may be included not only the true brittle stars, but also the sand stars, which have shorter and wider rays, and the basket stars, whose rays branch repeatedly. They are all important scavengers



DAISY BRITTLE STAR  
*Ophiopholis aculeata*

of the sea, often eating dead fish and sometimes fishermen's bait.

The brittle stars have five long sinuous arms, sharply differentiated from their disk-like bodies, to which their digestive and reproductive organs are confined. The ready mobility of their arms makes them the quickest of all echinoderms. They can escape from the grasp of an enemy by shedding their arms, which break into smaller and smaller bits. New arms soon grow to replace those lost. Some of the brittle stars have a wide range vertically, one species, *Ophiacanthia bidentata*, is found at depths from 16 to 14,000 feet. Some forms show phosphorescence.

**BRITTON, NATHANIEL LORD** (1859- ), American botanist. After graduating from Columbia University in 1879, he later became doctor of philosophy, and was instructor in geology and botany there until 1886, professor of zoölogy in 1887 and professor emeritus in 1896. From 1896 to 1929 he was director of the New York Botanical Gardens which he raised to one of the chief botanical institutions of the world. He was one of the leading systematic botanists of the United States, an authority on the flora of the eastern United States and Canada, and published a number of works on this subject including *Illustrated Flora of Northern United States and Canada*, 1896-98, and *Flora of Bermuda*, 1918. Britton was born at New Dorp, S.I., N.Y., Jan. 15, 1859.

**BRIX.** See **MOST.**

**BRNO** (German *Brünn*), a city in Czechoslovakia, the capital of MORAVIA. Brno has a Czech university and technological institute, an agricultural school and Conservatory of Music. The fortifications around the quaint old city have given way to parks and ring streets beyond which handsome suburbs have grown up. It is an important industrial city, particularly in the manufacture of textiles, machinery and leather; the large and numerous factories lie in the southern and eastern suburbs. Noteworthy are the Great Square,



the Vegetable Market with a fine fountain, and the Elizabeth Square and gardens. Brno has 17 churches, among them the 15th century Cathedral of St. Peter and Paul, the 14th century Gothic Church of St. James, and a synagogue in Moorish style. Other noteworthy structures are the government buildings, the city hall with a Gothic portal, the episcopal residence, and several abbeys. Pop. 1930, 263,646 of which about 60,000 were German.

**BROACH**, as applied to hand tools, a multi-sided **REAMER** used in small work. It is a tapered tool ground with three, four or five sides, the corners acting as cutting edges. In the modern machine shop, "broach" refers to a tapered tool having a series of cutting edges or teeth, usually on all sides, each tooth taking a small chip as the broach is pulled through a hole in the work. It is common practice to drill a round hole and pull a broach or series of broaches through it, changing the hole from a round to a square or another shape. In jewelers' parlance, a broach is a type of tapered reamer with five or more sides, the corners acting as teeth.

**BROACHING MACHINES** are used in machining internal or external surfaces by the use of tools having a series of cutting edges. *See* **BROACH**. The broach is pulled or pushed through, or along, the piece to be cut so that one tooth after another cuts a light chip. Originally used for cutting square or odd shaped holes after starting with a round, drilled hole, the practice has grown until many surfaces are now finished by broaching. In some cases broaching has supplanted reaming (*see* **REAMER**) in the finishing of round holes. Bands or buttons may be used after the last teeth on the broach to give a "burnished" surface.

Broaching machines both pull and push broaches through the work. Pull broaches are long and frequently slender and contain many teeth, each removing but a few thousandths of an inch. Push broaches are usually rather short. The spacing of the teeth and the metal cut by each tooth depends on the metal being machined, the length of the piece, the room necessary for chips and the accuracy required. Broaching machines were formerly usually operated by a screw which pulled the broach. Hydraulically operated machines are now quite common. Push broaches are frequently used in long stroke punch presses or in presses designed for other purposes. F. H. C.

**BROADCASTING**, the transmission of wireless signals (*see* **HERTZIAN WAVES**) in all directions, as opposed to directional transmission. *See also* **RADIO COMMUNICATION**.

**BROAD JUMPING**, distance jumping on the ground either from a standing position or after a short run. It was included in the Pentathlon at the ancient Olympic Games. It is stated that in one of these contests, Phayllus jumped 30 feet; if this is true, the athlete was undoubtedly aided by weights. This once popular method of gaining distance in the jump is little practiced to-day, weights being barred in all championship events.

In modern times, 20 feet was considered excellent

until in 1901 Peter O'Connor of Ireland made the phenomenal leap of 24 ft. 11¼ in. This record stood for 20 years, until a series of great Negro athletes successively broke all records. In 1921 E. O. Gourdin of Harvard University jumped 25 ft. 3 in. He was followed by Sol Butler and De Hart Hubbard of the University of Michigan, and S. Cator of Haiti, all Negroes, all of whom did over 25 ft. In 1925 Hubbard made a new record of 25 ft. 10⅞ in., surpassing this in 1927 with the amazing performance of 26 ft. 2 in.

The running broad jump is made, after a short fast run, from a wooden marker sunk in the ground and painted white. The jumper lands in a pit filled with loose earth. The distance is measured from the take-off to the nearest mark made by any part of the athlete's body. Until the time of Hubbard, athletes leaped with the knees tucked up close to the body. Modern jumpers take a hitch kick in air, adding greatly to the distance attained. The standing broad jump, made without a running start, is not as popular as it was a few years ago, and is now omitted from most outdoor championship programs, though still listed in some indoor meets. Standing jumpers have leaped more than 12 ft. without weights.

*See* Spaulding: National Collegiate Athletic Association, *Track and Field Rules Handbook*, 1931.

**BROADSIDE**, in naval gunnery, the whole number of guns which can be fired on either one of the two sides of a ship, particularly major caliber guns. The weight of all projectiles which can be fired on either side in **SALVO** frequently is spoken of as the weight of broadside. Turret guns commonly are mounted on the center line to permit firing either to port or starboard; while smaller guns usually are mounted outboard and can fire on only one side of the ship. *See also* **GUNNERY**.

**BROADSWORD**, a long, broad, single-edged, sharp-pointed military weapon, curved to a point on the cutting side, designed to cut and thrust. It is carried by commissioned and designated noncommissioned officers principally as part of their dress on official occasions, being seldom carried in battle.

**BROCA'S APHASIA**. *See* **APHASIA**.

**BROCCOLI**, one of the intermediate forms between wild cabbage (*Brassica oleracea*) and cauliflower, of which it is the progenitor. The flower heads, for which it is grown, are smaller, coarser, and slower in maturing than cauliflower or cabbage and are generally marketed green, not blanched. Though long cultivated in home gardens, it did not become prominent as a market vegetable until the early 20th century. Commercially it is grown in climates where the winters are mild. Young plants are started at the same time as late cabbage and set in the fields during summer. The heads are gathered in the following spring and summer.

**BROCK, SIR ISAAC** (1769-1812), British soldier, was born in Guernsey, Oct. 6, 1769. He entered the army at fifteen and by 1797 had become a lieutenant colonel. In 1811 he became a major general. In



the War of 1812, when General Hull invaded Canada with 2,500 men, Brock's strategy forced the surrender of the Americans. Later he took Detroit without a battle. A fine monument to Brock stands at Queens-town Heights where he was killed in battle, Oct. 13, 1812.

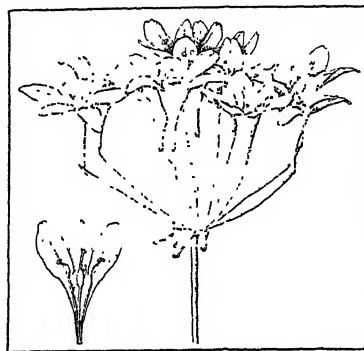
**BROCKEN, SPECTRE OF.** When favorably situated near a fog bank or cloud, one may see rings of colored LIGHT around the shadow which his head casts upon the cloud. This is called the Brocken Spectre or, mountain spectre, and is due to DIFFRACTION, by particles near the surface, of light reflected (see REFLECTION) from deeper portions of the fog or cloud. The amount of such diffracted light is greatest in the direction of incidence, i.e., from the shadow to the head or the source of light, thus giving rise to a halo around the shadow.

**BROCKHAUS, FRIEDRICH ARNOLD** (1772-1823), German publisher, was born in Dortmund May 4, 1772. In 1808 he purchased the copyright to an unfinished encyclopedia, *Konversations-Lexicon*, published the first edition in 1811 and in 1812 began a second. In 1818 he established the Brockhaus Publishing Co. which has continued, under his descendants, to publish his encyclopedia, now in its seventeenth edition. He undertook to publish an extensive work, the *Universal Encyclopedia*, still unfinished although 165 volumes have appeared. Brockhaus died at Leipzig Aug. 20, 1823.

**BROCKTON**, a city of Plymouth Co., southeastern Massachusetts, situated 20 mi. south of Boston. It is served by bus lines and the New Haven Railroad. There is a municipal airport. One of America's chief shoe-manufacturing cities, Brockton produces also elastic goods, shoe machinery, tools and blacking, for the manufacture of which the water supply is especially suited. In 1929 the factory output reached an approximate total of \$68,000,000; the retail trade amounted to \$35,830,831. The city is a trade center and the headquarters of the County Farm Bureau. Purchased from the Indians in 1649, the site was settled about 1700. The town was incorporated as North Bridgewater in 1821, but was renamed Brockton in 1874 and chartered as a city in 1881. William Cullen Bryant, the poet, once lived here. Pop. 1920, 66,254; 1930, 63,797.

**BROCKVILLE**, capital of Leeds Co., and port of entry of Ontario, Canada, on the St. Lawrence River at the foot of the Thousand Islands, 72 mi. south of Ottawa. A Canadian Pacific and Canadian National railway station, and port of call for Lake Ontario and St. Lawrence steamers, it is an important manufacturing and distributing center for creameries and condensaries. Among numerous other industrial products made here are hardware, felt hats and electric wires and cables. Brockville connects with Morristown, N.Y., by ferry, giving direct connections with the New York Central Railroad. A favored tourist resort to-day, Brockville was founded by United Empire Loyalists in 1784 and incorporated in 1832. Pop. 1921, 10,043; 1931, 9,736.

**BRODER PARK**, an island in the St. Lawrence River in the province of Ontario, Canada. The island, 20 acres in area, is well wooded and is a favorite summer recreation ground. Broder Park is near St. LAWRENCE ISLANDS PARK and is reached from Morrisburg on the Grand Trunk Railway.



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

PURPLE BRODIAEA OR GRASS NUT  
(*Brodiaea laxa*). A showy species abundant in adobe soils of California

**BRODIAEA**, a group of handsome plants of the lily family containing some 30 species native to western America, about 20 of which are found in California. The straight stems, which arise from corms, bear grasslike leaves and handsome blue, purple, yellow or white flowers in heads or in loose clusters. The spring star-flower (*B. uniflora*), native to Argentina, is cultivated for its bluish-white blossoms.

**BROKEN ENGLISH**, a language spoken in Sierra Leone by the descendants of the original settlers and by freed slaves from almost every part of west and southwest Africa. The vocabulary of this dialect, the mother-tongue of the inhabitants, is a corrupted English, while the syntax and some of the grammatical forms are African.

**BIBLIOGRAPHY.**—F. W. H. Migeod, *The Languages of West Africa*, 2 Vols., 1911-13.

**BROKEN HILL**, a town in mid-western New South Wales, Australia, situated on a high ridge near the boundary of South Australia. It is located in a rich mining area, which has been operated since 1884. Large quantities of zinc, lead, silver and other ores are mined, and exported to other parts of the world, but a large proportion of the ores are shipped to South Australia for reduction. Pop. 1929, 23,260.

**BROKER**, in finance a middleman who brings together buyers and sellers of the same securities or commodities; also, in a more general sense, the member of a stock or commodity exchange. All exchange (see STOCK EXCHANGE) members, however, are not brokers as a broker deals for compensation based on commissions and exchange members cease to function as brokers when they buy and sell securities for their own profit. The broker is well informed in the technique of his particular market, knowing the sources of supply and demand and being an expert on prices and price trends. A stock broker is bound

both by law and the rules of his exchange. The commission broker is perhaps the most important. He is usually the floor partner of a stock exchange house whose orders he executes on the floor of the exchange. This class of broker also borrows money in behalf of his margin customers, becoming their creditor. He charges what such money costs and can hypothecate, but not sell, the securities of his customers. See STOCK BROKER; STOCK JOBBER.

**BROMBERG** or **BYDGOSZCZ**, a city in the Polish voievodship Poznan, 7 mi. west of the Vistula; until 1918 capital of the Prussian district of Bromberg. An industrial city situated near the River Brda, it is noted as the scene of the annual Polish rowing championships. Bromberg has a large Jesuit church on the spacious market place, vocational and other schools and a theater. Besides trade in lumber, grain and flour, there is considerable industry, particularly milling, tanning and making of vinegar. Bromberg's origin is prehistoric; it was a trading post of importance in early times. Est. pop. 1930, 118,274.

**BROME GRASS** (*Bromus*), the name given to a group of numerous grasses, comprising about 100 species found in temperate regions. About 25 are native to the United States and 17 have been introduced. They are mostly of medium size, with large flowering spikelets. Several are cultivated for forage, as Schrader's brome or rescue grass (*B. unioloides*), grown in the southern states, and the Hungarian brome (*B. inermis*), cultivated from Montana to Kansas.

**BROMELIAS**, a numerous family (*Bromeliaceæ*), of tropical plants, comprising about 850 species. While some grow on dry rocks, they are chiefly epiphytes (perching plants) and form a more characteristic feature in the vegetation of the American tropics than do the orchids. Bromelias are short-stemmed plants, with rigid channeled, often scurfy and spiny leaves, and showy flowers. To this family belong the pineapple, one of the finest tropical fruits, now widely cultivated, and the Spanish moss or long moss (*Tillandsia usneoides*), widespread in the southern United States, especially on live oaks.

**BROMIDES**, the most important compounds of bromine, the principal uses of which are in photography, medicine and gold mining.

For photography, a thin coating of a light-sensitive silver bromide emulsion is applied to the surface of a suitable support, such as celluloid film or paper. The emulsion is formed by adding a solution of silver nitrate to one of potassium bromide containing gelatine. The jelly is treated to wash out soluble salts, and the purified product melted and spread upon the support.

In medicine, bromides are especially valuable for their sedative effect upon the nervous system without affecting the circulatory or other vital functions, even when given in large doses. They are used to check convulsions, alleviate pain, promote sleep and soothe nervous excitation, particularly in the treatment of epilepsy, whooping cough, asthma, neuralgia, delirium

and nervous disorders generally. For continued use, SODIUM BROMIDE is preferable to POTASSIUM BROMIDE, being less prone to disturb the stomach. Ammonium bromide is given when a stimulant as well as sedative is desired.

A mixture of five parts of sodium bromide and one part sodium bromate, known as "mining salt," which yields free bromine when treated with an acid, is used in gold mining (see METAL MINING). E. C. B.

**BROMINE**, a deep red-brown, liquid element (symbol, Br), which forms brown fumes having a strong pungent odor, and is extremely irritating even when very dilute. One part of bromine in 100,000 parts of air will affect the mucous membranes. Sp. gr., 3.187; at. wt., 79.72; boiling point, 59° C.

Bromine combines with other elements, as silver, sodium, magnesium and potassium to form *bromides*. In combination with hydrogen, it forms hydrobromic acid (HBr) which is gaseous and used only in solution.

Compounds of bromine are found accompanying other salts in natural brines and mineral waters, or in salt deposits. Ocean water contains about 60 parts of bromine per million. The principal sources of supply are the mother liquors from the potash salt works at Stassfurt, Germany; in Alsace, France; and the natural brines occurring near Midland, Michigan. The extraction process consists in treating the raw brine with chlorine to liberate the bromine, removing the bromine as vapor by steaming out or by blowing out with air, and condensing the bromine vapors directly as liquid, or, when mixed with a large volume of air, absorbing the vapors in an alkali.

Bromine is used chiefly in the form of its compounds, either BROMIDES, or organic chemical derivatives. Among the latter are DYES. In the manufacture of tetra-ethyl lead, ethyl bromide and ethylene dibromide are essential, the first as a raw material and the latter as the solvent for the lead compound. E. C. B.

**BRONCHIECTASIS.** See RESPIRATORY DISEASES.

**BRONCHITIS**, inflammation of the mucous membrane of the bronchial tubes due to colds or following a variety of other diseases.

Simple colds generally affect the trachea and larger bronchi together, and the condition is the *acute* form which may be known as tracheo-bronchitis. The lining membrane of the bronchi becomes pink and sensitive and secretes an excessive amount of watery fluid or mucus.

Acute bronchitis begins with fever and other symptoms of a cold, such as muscle pains and backache. There is a great deal of coughing and expectoration of much watery sputum. Within a few days the irritation producing the cough becomes less, the sputum gets "looser" and in a week or two the trouble subsides.

The chief measure in the treatment of acute bronchitis is protection from exposure. Permitting exposure may allow the infection to descend deeper into the lung and thus cause pneumonia. In severe bron-

chitis the patient should be put to bed and in all instances should be kept indoors. The use of drugs to be breathed in, such as compound tincture of benzoin, often helps the condition and mustard plaster over the chest may bring relief. Cough remedies are also given at the beginning of the disorder. Later on, drugs, such as ammonium chloride, which tend to increase the amount of sputum, are advisable.

As the result of repeated attacks of acute bronchitis, *chronic bronchitis* occurs. It also may accompany heart and pulmonary affections, as well as diseases of the kidney. It is also to be found in elderly individuals.

In some cases of chronic bronchitis the lining membrane of the bronchi usually becomes thinned out, and the tubes are dilated; in other instances the lining membrane may become thick and swollen.

The symptoms usually observed are breathlessness during exercise, and a cough, varying in amount and severity, which brings up much thick sputum. Fever is rarely present. During the warm weather the patient is usually free from cough, but each winter the cough that comes on is more severe and persistent.

Even in the most changeable weather, there are some things that can be done to prevent the onset of the chronic attacks of bronchitis. Warm but light underclothing should be used. Breathing exercises to increase the expansion of the lungs and the action of the diaphragm are helpful in some cases. The use of vaccines has been suggested. Drugs will not bring about a cure. *See also* CHILDREN, DISEASES OF: Respiratory Diseases. W. I. F.

**BRONCHOPNEUMONIA.** *See* PNEUMONIA.

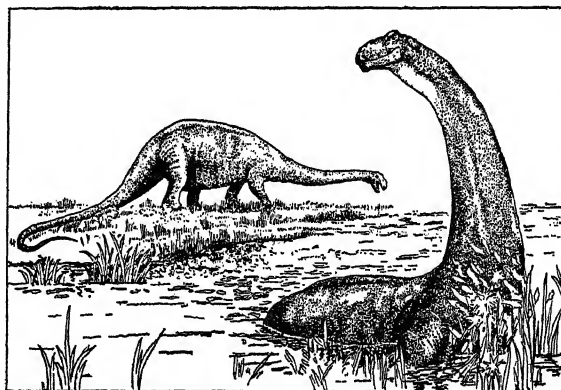
**BRONCHUS.** *See* LUNG.

**BRONTË FAMILY,** CHARLOTTE (1816-55), EMILY (1818-48), ANNE (1820-49), English novelists and poets, daughters of Patrick Brontë, an Irish Protestant clergyman. They were all born at Thornton, near Bradford, where their father was a curate, Charlotte in Apr. 21, 1816; Emily, July 30, 1818, and Anne, Jan. 17, 1820. In 1820, when Patrick Brontë became rector at Haworth, the girls were taken to the home they were to make famous in English literature. Their mother died soon after the removal and their father, an unsocial man, paid slight attention to them, so that they grew up on this isolated, wild Yorkshire moor dependent almost wholly upon one another for society. They read, studied, took long walks over the moors and gave evidence of their unusual gifts in the enormous amount of childish "literature" they produced. Before she was 15 Charlotte alone had written 23 "novels." The girls' education was obtained partly at home, partly at small local schools. In 1842 Emily and Charlotte attended a large school for girls at Brussels, to which Charlotte returned for a year as a teacher. In 1846 the three published jointly a volume of poems over the pen names, Currer, Ellis and Acton Bell. Anne's *Agnes Grey*, Emily's *Wuthering Heights* and Charlotte's *Jane Eyre* were all published in 1847 over their pseudonyms. The first two attracted little attention, but *Jane Eyre* was an immediate success and

"Currer Bell" was acclaimed one of the great novelists of the time. Emily fell ill and left some unpublished poems on her death at Haworth, Dec. 19, 1848. Anne also sickened, of consumption, but wrote *The Tenant of Wildfell Hall* before her death at Scarborough, May 26, 1849. Charlotte's *Shirley*, of special interest for its idealized but vivid portraiture of Emily as its heroine, appeared in 1849, and *Villette*, with the scene laid in Brussels, in 1853. *The Professor* was published after her death at Haworth, Mar. 31, 1855. Anne's novels and poems are less striking, powerful and individual than the work of her sisters, but they have grace and distinction and are interesting in themselves aside from being a factor in the Brontë tradition. Some of her hymns are still sung. Emily's genius as poet and novelist began to be recognized after her death and many critics have long considered it greater than that of her sister. Some of her poems are notable poetic achievements. Both these and her novel show the moving power of intense emotion and of a somber, keen imagination. Charlotte struck out a new, unconventional and distinctive path in fiction, and her novels have been a vital influence in English literature. *See also* ENGLISH LITERATURE.

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**BRONTOSAURUS**, a gigantic amphibious dinosaur, in appearance somewhat like an elephant but with the neck and tail of an enormous snake. The exceedingly small head held a brain only little larger than a man's fist. The largest known brontosaurus skeleton, from Jurassic deposits at Como Bouffs, Wyo., has recently been installed in Peabody Museum, Yale



COURTESY AMER. MUS. OF NATL. HISTORY

**BRONTOSAURUS, THE THUNDER REPTILE**

*Drawn by Charles R. Knight from a reconstruction. This mammoth dinosaur is shown as dwelling chiefly in the water where it is supposed to have passed most of its time, feeding upon water plants*

University. It measures nearly 70 ft. in length. The living animal probably weighed between 37 and 40 tons. Of water-plants, forming its diet, it must have consumed daily several hundred pounds. Opinions differ as to whether, without the buoyant support of water, the ponderous creature could walk. The nostrils, opening on the top of the nose, permitted the reptile to lie practically submerged. The heavy limbs,

like the leaded boots of a diver, with the light superstructure, enabled Brontosaurus to wade four-footed in 40 ft. of water, or erect its body, like a bascule bridge.

**BRONXVILLE**, a residential village in Westchester Co., southeastern New York. It is situated on the Bronx River, 15 mi. northwest of New York City and is served by the New York Central railroad. Bronxville is the seat of Sarah Lawrence College, Concordia Institute and Brantwood Hall School. The village was incorporated in 1898. Pop. 1920, 3,055; 1930, 6,387.

**BRONZE**, a name generally applied to copper-tin alloys and also to certain copper-zinc alloys because of their color. These latter alloys include manganese bronze, Tobin bronze, architectural bronze, hardware bronze and commercial bronze. If the copper-tin alloys are deoxidized with phosphorus they are called phosphor-bronzes; if the deoxidizer is silicon, they are called silicon bronzes. For wrought alloys the tin varies up to 10%, and for sand cast alloys the tin may go as high as 20%. The copper-tin alloys when properly produced have a fine-grained structure which gives them high tensile strength, elastic limit, resistance to fatigue and resistance to corrosion. These properties make copper-tin alloys useful engineering materials. Aluminum bronzes are copper-aluminum alloys containing up to 10% aluminum, occasionally with small additions of iron. They are useful where strength and resistance to corrosion and wear are essential, such as pump parts, gears, diaphragms, pickling equipment and valve seats for internal combustion engines. *See also* BRONZE AND BRASS IN ART.

W. H. B.

**BRONZE AGE**, the period of human culture in which bronze gradually displaced stone for weapons and implements, thus closing the NEOLITHIC PERIOD, or New Stone Age. Ancient bronze was generally an alloy of nine parts of copper with one part of tin, to increase the hardness of the copper. The period in which this hard alloy was used was thus naturally preceded by a period in which implements were made of pure copper.

Copper implements have been found at Anau, Turkestan, to which an age of 9,000 or 10,000 years has been assigned. Copper lions from Tel-el-Obeid in Mesopotamia are believed to have been made 5,500 years ago. Cast copper axes found at Kish, also in Mesopotamia, are about the same age. Copper was known in Egypt in the second pre-dynastic period, not less than 6,000 or 7,000 years ago. The Egyptians may have got their copper by reducing malachite, or carbonate of copper in a fire of charcoal. Native copper is found in many countries. It can be hammered into shape without heating, and is made harder by this process.

Bronze was probably discovered 5,000 years ago. In many countries, as in England and Spain, both copper and tin are found. Surface copper ores sometimes contain tin oxide. In reducing these ores the mixture of the two metals, as bronze, may have been accidentally happened on, and the hardness of the re-

sulting alloy noted and sought after. Since the development of bronze weapons, implements and ornaments can be traced farthest back in Asia, it is thought that bronze was discovered in some Asiatic country, and that the knowledge of the art of alloying copper with one-tenth of its weight of tin gradually spread westward, to Egypt, Asia Minor and Europe. At Luristan, Persia, a series of beautiful and elaborately decorated weapons, implements and ornaments of bronze have recently been discovered, in cemeteries scattered over a considerable area, and probably 4,000 years old. These include axes of several forms, daggers, a bronze whetstone with an ibex-head handle, many bracelets, a cup with a handle representing a bird, decorations of animals facing each other, such as lions, and many other beautiful objects.

As illustrating the eastward extension of the use of bronze may be mentioned recent excavations in China, in the district of Hsiao Tun Tsun, near An Yang, in the province of Honan. This locality was a capital of the Shang Dynasty, about 1500 B.C. Here were found many bronze weapons and ornaments, including socketed spear heads, knives, socketed axes and arrowheads. At the same site and of the same date were found richly patterned pottery, and also bones inscribed with the most ancient form of writing so far known in China, from which the later characters were developed. The Bronze Age in China thus comes down to the period of written history. As illustrating the same subject, it may be noted that the Egyptian hieroglyphic inscriptions are held by some authorities to have been cut with implements of flint, on rocks too hard for cutting with bronze or iron, thus making the Stone Age overlap the age of written history in this particular.

The development of the Bronze Age from the polished weapons and implements of the New Stone Age in Eastern Europe is well illustrated by the accurately determined stages of the Minoan culture in Crete, the Mediterranean island centrally situated between Asia Minor, Egypt and Greece, and therefore a natural stepping stone for the older cultures passing to Europe. The early Minoan period had implements of copper. In the middle Minoan bronze implements were present, with a ten per cent alloy of tin. The same transition is shown at the site of Troy, now called Hissarlik, in Asia Minor, where the oldest layer of deposits contains implements of polished stone, while the layer immediately above contains bronze weapons. At a later date, in the Troy described by Homer, the Bronze Age was already passing into the IRON AGE. The knowledge of bronze appears to have passed through Greece and Italy to central Europe.

In the Swiss lake dwellings the settlements nearer the shore belong to the New Stone Age of polished flint implements, which possessed a knowledge of the domestication of horses, cattle, sheep, goats, and pigs, dogs being kept to guard the flocks. At that period agriculture had been established, pottery was made and flax was woven into textiles. Settlements farther

out, in deeper water, in the same lakes show the presence of bronze implements as well as progress in other lines. Thus woolen fabric were woven, as well as flax; oats had been added to wheat, barley and millet, and finer pottery was made. But no break of continuity is apparent.

From central Europe the knowledge of bronze soon extended northward and westward, reaching France and Spain, where both copper and tin are found, about 4,000 years ago. The method of making bronze also spread to Scandinavia. Montelius, leading archaeologist of Sweden, has linked Scandinavian chronology with that established by Baron de Geer based on a count of layers of sediment left by the retreating ice of the last glacial period. Montelius divides the Bronze Age in Sweden into five periods, each distinguished by certain styles of implements, weapons and ornaments. These periods with dates are: I. (1900-1600 B.C.) with flat bronze axes, daggers, armlets and neck rings in incomplete circles, pins and pottery with handles; II. (1600-1400 B.C.) with more developed axes, swords, necklets, bronze collars, arm rings, ornaments, fibulae somewhat like hatpins and better pottery; III. (1400-1050 B.C.) with socketed axes, fibulae, buckles with disks of bronze wire wound in spirals and more elaborate jars and pitchers; IV. (1050-850 B.C.) axes with turned over flanges, sickles and razors; V. (850-650 B.C.) swords with decorated hilts, highly developed ornaments and new styles of pottery. This fifth stage was followed by the Iron Age.

In America some tribes of Indians had learned to make ornaments of native copper. Bronze was known in Mexico and Peru, where the Bronze Age lasted until the Spanish conquerors brought iron and steel in the 16th century. See ARCHAEOLOGY. C. J.

**BRONZE AND BRASS IN ART.** Any helpful data concerning the discovery of bronze has been lost in the haze of prehistoric uncertainty. Tradition establishes the fact that it was first made in the 3rd millennium B.C.; but whether Egypt or China deserves the credit for actual precedence is a question which in all probability will always furnish material for learned discussion.

**Egyptian, Mycenaean and Hellenic.** What is thought to be the earliest piece of bronze extant was found in a Neolithic deposit in the palace of Minos in Crete. It is a flat celt, supposedly of Egyptian origin, of the 4th century B.C. If this date is correct, bronze did not come into common use for another 1000 years. The ancient Egyptian, Mycenaean and Hellenic civilizations all made images of their gods, weapons, decorative statues and household articles of bronze. Much bronze furniture has been found in the tombs of the Old Empire in Egypt, such as stools, beds, boxes and spoons. The best piece of bronze from the Minoan civilization is a small bull with an acrobat on his back which dates from about 2000 B.C. The Charioteer of Delphi is a famous piece of early Greek bronze. The so-called bronzes of Siris, now in the British Museum, are pieces of an ancient Greek cuirass found near the

gulf of Tarento in what was Italian Greece. On the fragments are representations of two Greek heroes fighting Amazons which are unrivaled as examples of repoussé bronze. The work is undoubtedly of the school of Lysippus of the 4th century B.C. Ancient Babylonians and Assyrians also did excellent work in bronze, of which we have weapons, statues, utensils and toilet articles as examples. Copper was found in the mountains of Greece and Asia Minor. It is not known where tin for the early bronzes was found; one theory is that tin may have been brought from Germany with importations of amber.

**European.** The lake dwellers of Switzerland used bronze articles which have been found on the bottom of the Swiss lakes mixed with Neolithic implements. From the remains of one settlement on Lake Neuchâtel 60 rings for the arms and legs, several elaborate rings for the neck and 200 hairpins, some over a foot in length, in addition to bronze implements and weapons were taken. Etruscan tombs have yielded exquisitely wrought hand mirrors and toilet caskets. The famous Capitoline Wolf is the best known piece of Etruscan bronze. The huge bronze chimera now in Florence is also Etruscan. The best known bronzes from Pompeii and Herculaneum are the statues of Narcissus, Hermes, the *Sleeping* or *Drunken Faun*, and the so-called head of Plato. The four bronze horses in front of St. Marks, Venice, are also famous among old bronzes. The National Museum at Naples has over 14,000 examples of bronzes found in Italy.

Charlemagne gave new zest to the production of bronze as well as to the other arts. He had admired the bronze in Italy and appropriated much of it to be melted down and recast into fittings for the palace at Aix-la-Chapelle. The bronze doors at Aix-la-Chapelle have the first of the Sanctuary Rings which are characteristic of mediaeval bronze doors. The immediate inspiration for these rings which later developed into knockers is unknown.

Medieval bronze work was largely ecclesiastical and specialized in shrines, reliquaries, censers, fonts, tombs and elaborate candlesticks, candelabra and chandeliers. The town of Dinant on the Meuse in Belgium is especially associated with the medieval manufacture of domestic and ecclesiastical bronze objects. The masters of the Italian Renaissance returned to the classic manner of composition and design in bronze, and with the exception of the great period of Greek



COURTESY M. M. OF ART

EGYPTIAN BRONZE STATUETTE  
OF THE 18TH DYNASTY  
*Sekhmet, goddess with the head  
of a lioness*



art there was never a period when more outstanding works of art were produced.

**Far East.** According to Chinese tradition Yu the Great, founder of the First Dynasty (the Hsia, 2205 B.C.) decreed that tribute metal from nine subject provinces should be melted down and cast into nine bronze caldrons for cooking the food offered in sacrifice at the Altar of Heaven. A summary catalogue giving the designs of these bronze receptacles has been preserved. The bronzes were used as the central object on all grand ceremonial occasions until 233 B.C. when they disappeared. All ancient Chinese bronzes were for religious and ceremonial use. Vessels like those above are called *ting* and were used for meat offerings; *tsun* were wine jars; *chung* were bells to be rung during sacrifice. Others were for peace offerings, oblations, storage of sacrifice, and other rites. The Government Museum at Peiping has examples of 73 different shapes each with a specific ritualistic use. The decorations of these bronzes vary from simple scroll to elaborate designs covering the inside as well as the outside and frequently inlaid with gold and silver. The decoration is all symbolic. An ogre, for example, is a warning against greed; a dragon is an omen of spring showers.

The art of casting bronze was introduced to Japan by Chinese Buddhist priests about 552 A.D. These priests taught their converts the arts of wood carving and of working in metal. The earliest important example of Japanese bronze is a colossal sitting image of Bharcha-djyaguru in the temple of Yakushiji cast, supposedly by a Korean monk, Giogi, about 700. The next is a huge bell 13½ feet high which was cast in 732 for the Todai Temple, also at Nara in Japan. The Japanese are excelled by none in their bronze work. They have developed 70 different alloys in the history of their bronze working of which 30 are in use at the present time.

India is famed for its brass articles, such as Indian spice boxes, vases, water vessels, and trays which are elaborately decorated with enamel, damaskeening, and niello. From Java and Ceylon of the 9th century come the most technically perfect of all small Indian bronzes. They are small Malayana Buddhist figures. Later bronzes of this phase of Sinhalese Buddhism are grotesque. In the dense jungles of Siam are old Buddhas which are still in perfect condition, though the temples which sheltered them have long since disappeared.



18TH CENTURY  
BRASS STATUE OF  
THE HINDU GOD,  
GANESHA

**South America.** At Machu Picchu, the ancient Inca city of Peru, have been found many interesting bronze articles, such as bracelets and necklaces, bronze spoons with coy little birds on the handle, tiny hair tweezers and mirrors. Of particular interest was a bronze knife which has on the back of the blade a little man holding a big fish on the end of a huge rope.

**Mirrors.** The oldest mirrors are Egyptian and are found in the tombs of the 4th and 5th dynasties. They are of bronze and their form and decoration had a definite significance. They were generally made in the shape of the solar disk, that is a slightly flattened circle simulating the appearance of the sun on the horizon or through a haze. This made an appropriate association between the sun god, Ra, and the mirror whose usefulness depended upon the light of the sun god. Hathor, goddess of love, commonly decorated the handles. Mirrors were made in China in 1200 B.C., but the oldest mirror extant is from the Han period, 209 B.C. to 250 A.D. They were frequently placed in graves, supposedly to comfort the souls of the departed in their dark home. The oldest Greek mirrors date from the 5th century B.C. Mirrors have been found in Great Britain contemporary with the Roman occupation. A tiny bronze mirror was found at Machu Picchu in Peru. All of these mirrors consist of a single metal disk with the exception of some from Greece which consisted of two mirrors hinged together, the top one forming the cover and decorated on the back. Etruscan, Egyptian and Roman mirrors all had handles, usually of metal but occasionally of wood. The Chinese treated their mirrors with mercury to give them added brilliancy.

**Doors.** Excavations at the ancient Assyrian city of Balawâ have unearthed a huge pair of gates to the palace erected under the direction of Assurnazirpal II about 800 B.C. These gates have bands of sheet bronze decorated with historical scenes in relief. They are now in the British Museum. Next in historical interest come the massive bronze doors of the Roman Pantheon erected in 124 A.D. and the 8th century Byzantine doors of Hagia Sophia in Constantinople. These doors as well as the doors of the early Middle Ages such as the 11th century doors of Hildesheim Cathedral by Bishop Bernward, St. Paul's outside of the walls of Rome and the Byzantine gates at Amalfi are all of thin bronze with the design hammered in. In the 15th century the first solid bronze doors were made, the most famous of which are the doors of the Baptistry of the Cathedral in Florence. One set of doors was executed by Andrea Pisano. The east doors, designed by Lorenzo Ghiberti, are the most famous bronze doors in the world. They are composed of 10 square panels representing scenes from the Old Testament. Each door is outlined by narrow strips of Biblical characters. Michelangelo said these doors were worthy to be the "Gates of Paradise." Famous bronze doors in the United States are those of the Capitol at Washington, D.C., the doors of the Congressional Library, and the doors of St. Bartholomew's Church in New York City.

**Bells.** The founding of bronze bells has been an important industry in Europe and England since the beginning of the Middle Ages. Many of the old bells have been taken down and cast into guns in time of war; but medieval bells still ring in Chartres and Rheims in France, Erfurt in Germany and in a few other of the old cathedrals. The largest bell ever cast

was the Great Bell of Moscow cast in 1733. It measured 21 ft. across by 21 ft. in height and weighed 432,000 pounds. It fell four years after it was hung as the result of a fire and now forms the dome of a chapel. The Bourdon bell of the Riverside Church in New York City is the largest bell ever cast to strike a definite note. It weighs 20 tons, exceeding Big Ben of Westminster by six tons, and carries low C of the carillon.

**Tombs.** The most notable collection of mediaeval bronze sarcophagi is in Westminster. The sides of these tombs are usually decorated with Biblical scenes in relief or with scenes from the life of the deceased such as the battles he has won. Outstanding among the sarcophagi at Westminster with effigies recumbent on the lid are those of Edward III, Henry VI and Queen Eleanor, designed by William Torrell in 1291, and of Richard II and his queen, by Nicholas Broke and Godfrey Prest in 1395. Frequently only the tombs were of bronze and the figures in some other material, as for example two 15th century tombs in Bruges, one of Mary of Burgundy which has the effigy of the lady in stone and the other of her father, Charles the Bold, which is in gilt copper.

**Patina.** There is as great a difference between a natural patina and an artificial one as between jade and green glass. The natural patina was called *aerugo nobilis* by the ancients. The natural patina of bronze is of various shades depending upon the climate, the soil, and the exposure of the article. The color generally associated with bronze patina is a green blue. Those pieces of ancient Chinese bronze which have been found in tightly sealed tombs, away from dampness, have a bright kingfisher blue patina; articles found in damp earth have a grayish green patina, like the rind of a melon. Articles which have been exposed to the air through the centuries have a dark brown color with red patches. There are many methods of producing artificial patina. It is usually developed by exposing the metal while hot to various vapors. Sulphur, for example, produces a jet black patina. The Greeks produced an excellent simulation of natural patina with soured wine. Oxidation of bronze whether by weather or artificial means affects only the surface. Under the patina the original color remains undimmed; hence bronze is called the "eternal metal."

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**BRONZITE**, a grayish-green, or olive green to brown mineral frequently characterized by a bronze-like luster, whence the name. It is a common constituent of PERIDOTITES and of SERPENTINES derived from them, of crystalline SCHISTS and of certain meteoric stones. Bronzite is a magnesium-iron silicate of the PYROXENE group, intermediate between the magnesium form enstatite, and the feriferous form hypersthene. See also PETROLOGY; METEORITE.

**BROOKE, RUPERT** (1887-1915), English poet, was born at Rugby, where his father was assistant master, Aug. 3, 1887. He was educated there and

at Cambridge. He studied in Munich before settling down at the Old Vicarage, Grantchester, to write. In 1913 he visited America and the South Seas. In Sept. 1914 he secured a commission in the Royal Naval Division and was sent on the expedition to Antwerp. In Feb. 1915 he sailed for the Dardanelles with the British Mediterranean Expeditionary Force. He died from blood poisoning at Scyros, Apr. 23, 1915, and was buried there. A collected edition of his poems was published in 1915.

**BROOKE, STOPFORD AUGUSTUS** (1832-1916), British clergyman and author, was born at Letterkenny, Ireland, in 1832. He was educated at Trinity College, Dublin, and ordained in 1857 in the Church of England. Among other positions in London, he was chaplain in ordinary to Queen Victoria, but in 1880 he seceded from the Church and became a Unitarian. Among Brooke's noted works are *The History of Early English Literature*, *Tennyson: His Art and Relation to Modern Life*, *Poetry of Robert Browning* and *Life Superlative*, 1906. He died at Ewhurst, Surrey, Mar. 18, 1916.

**BROOK FARM**, a celebrated community project, which numbered Nathaniel Hawthorne, Charles A. Dana, Ralph W. Emerson, Amos Bronson Alcott, Margaret Fuller, and Theodore Parker among its leaders. It was organized in 1841 and located on a 160-acre farm near West Roxbury, Mass. The community was organized by George Ripley, who had been a Unitarian minister, and his wife, Sophia Dana Ripley. Their purpose was to establish a society for liberal and intelligent men and women, more particularly for those with leanings toward the Transcendental movement in New England. To maintain the community, members shared alike the work of operating Brook Farm. Schools were provided for children of members and outside students. Fire destroyed the main building on Mar. 2, 1846, and this, combined with the increasing difficulty of financing the community, led to its dissolution in Oct. 1847. The project, an early experiment in developing cooperative society, provoked discussion on both sides of the Atlantic. See BLITHEDALE ROMANCE.

**BROOKFIELD**, a suburb of Chicago, a residential city of northeastern Illinois, in Cook Co., founded in 1892. It is served by the Chicago, Burlington and Quincy Railroad. In 1929 the retail trade amounted approximately to \$1,430,000. Pop. 1920, 3,589; 1930, 10,035.

**BROOKFIELD**, a city in northern Missouri, in Linn Co., situated about 25 mi. east of Chillicothe. Bus lines and the Chicago, Burlington and Quincy Railroad serve the city. Brookfield manufactures shoes and railroad-shop products; it is in the Lafayette coal field region. Founded in 1859, Brookfield was incorporated in 1868. Pop. 1920, 6,304; 1930, 6,428.

**BROOKHAVEN**, a city in southwestern Mississippi, the county seat of Lincoln Co., situated in a heavily forested region, 129 mi. north of New Orleans. Buses and two railroads afford transportation. Brook-

BRONZE AND BRASS, IN ART



COURTESY METROPOLITAN MUSEUM OF ART

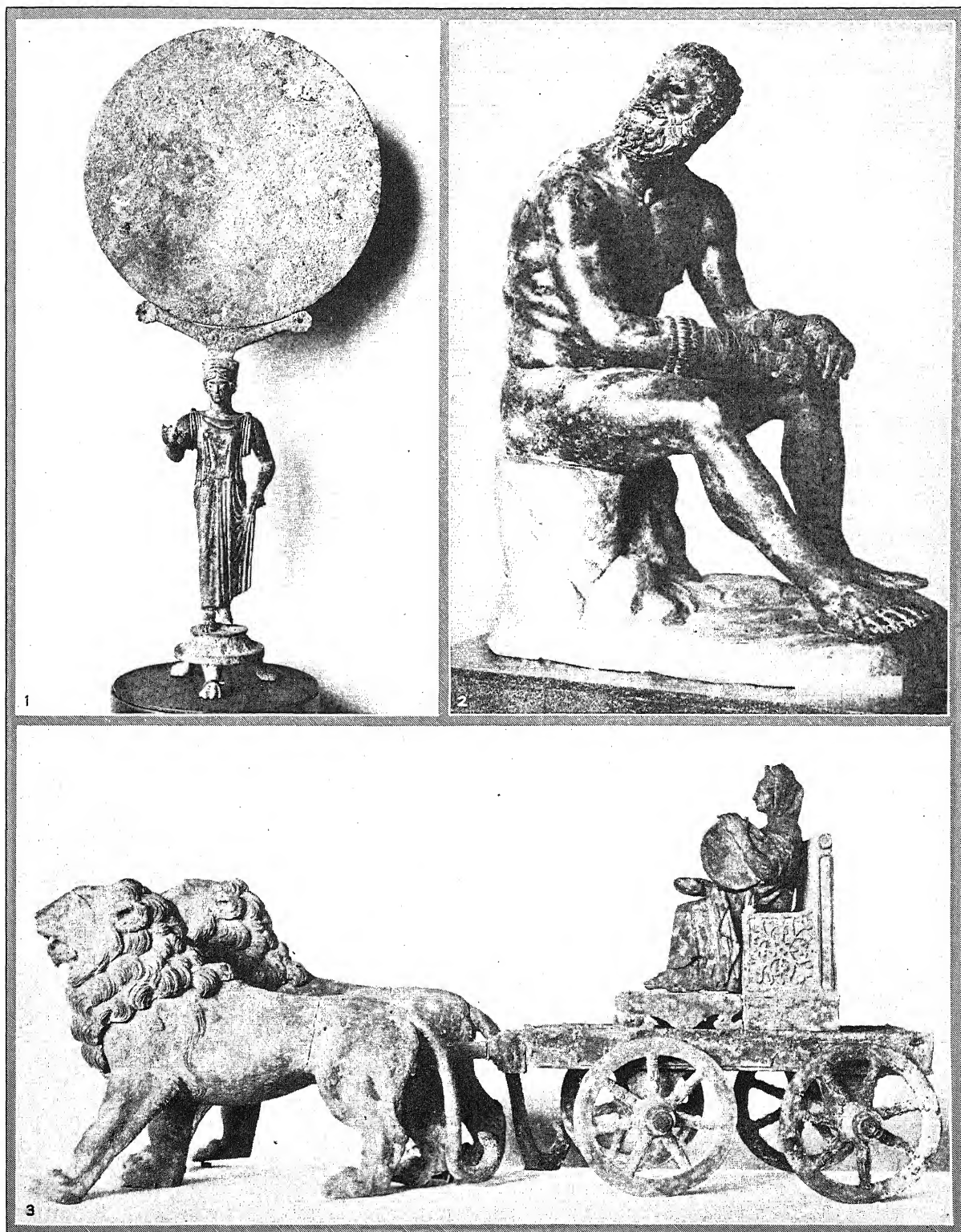
CHINESE SACRIFICIAL VESSEL

Bronze vessel of the Chou Dynasty, dating from about 1112 B.C.





## BRONZE AND BRASS, IN ART



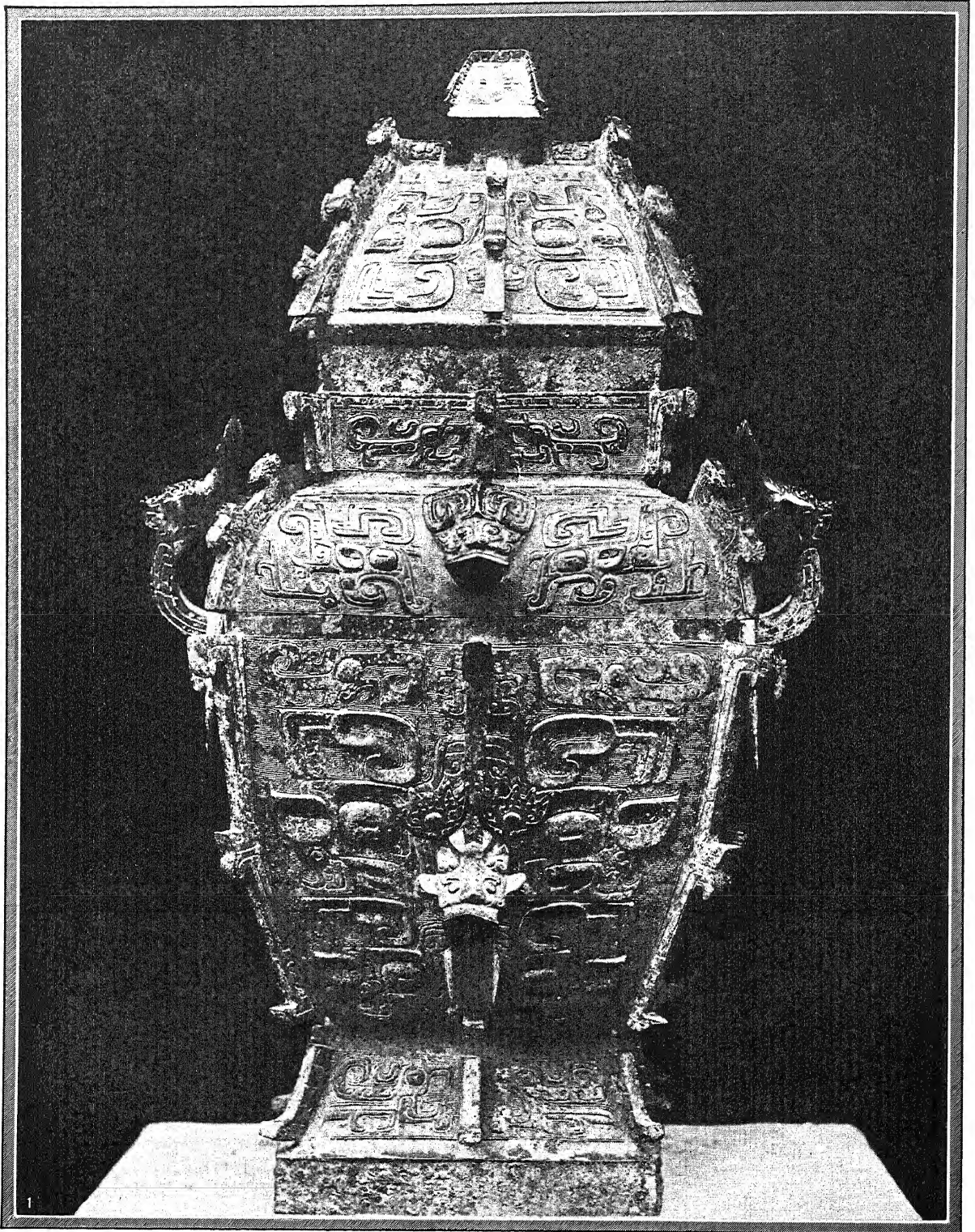
COURTESY METROPOLITAN MUSEUM OF ART

### ANCIENT FIGURES DONE IN BRONZE

1. Greek mirror, supported by a female figure made of bronze.
2. Bronze statue of a boxer, in the Terme Museum, Rome.
3. Second-century bronze representation of Cybele on processional car drawn by two lions.



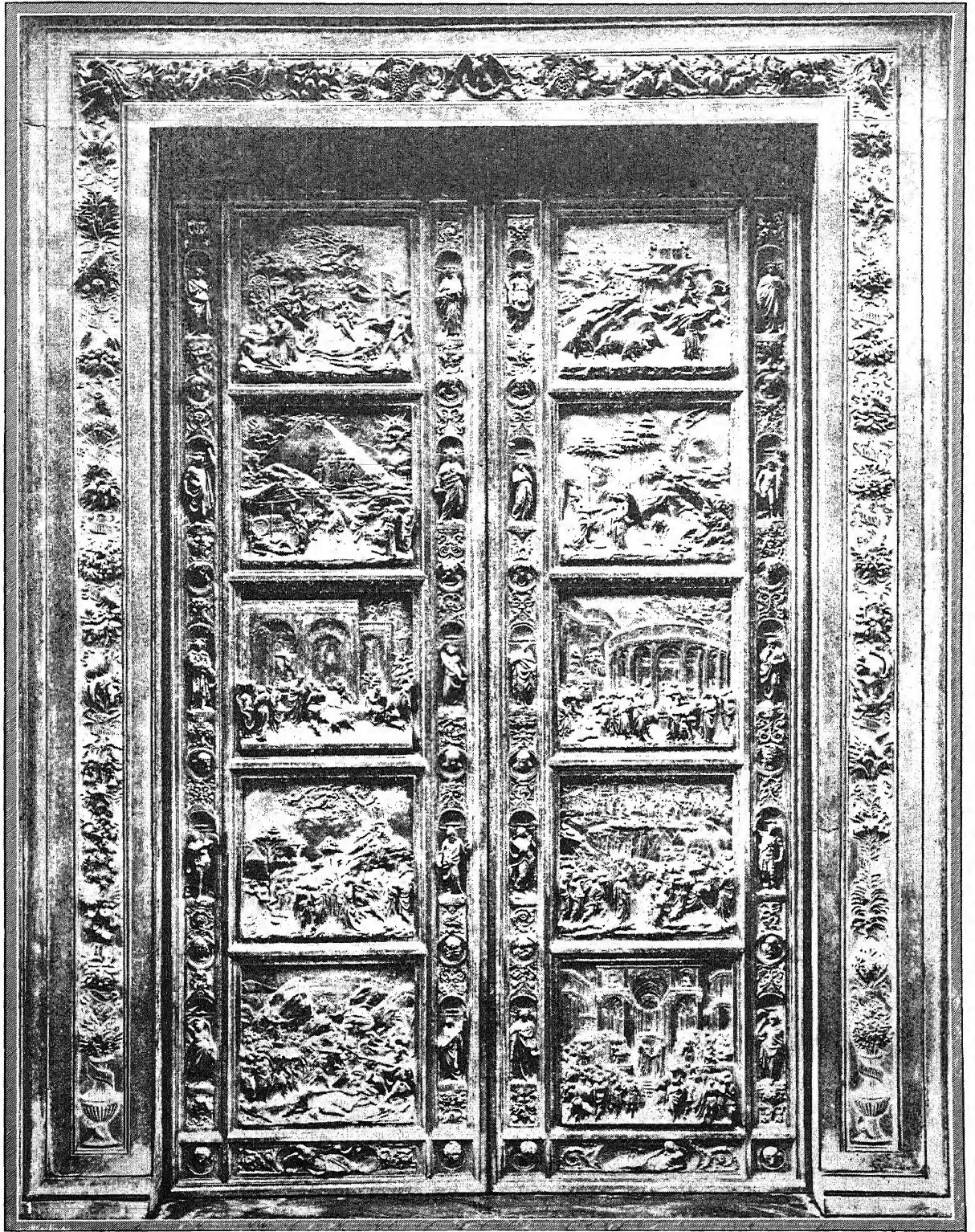
## BRONZE AND BRASS, IN ART



COURTESY C. T. LOO, ESQ.

### CHINESE BRONZE COVERED VESSEL

Chou period (500-350 B.C.). 24½ in. high. Traditional motives of the t'ao-t'ieh mask and k'uei dragon are modeled in low relief upon a ground of squared spirals. Loops, bearing antlered animal heads, project from each side of the vessel.



GHIBERTI'S FAMOUS BRONZE DOOR

The eastern door of the Baptistery of St. John, in Florence, is the work of Lorenzo Ghiberti (1381-1456), who pictured, in high relief, ten scenes from the Old Testament.



haven is a trade center for a large timber-cutting and farming district, and ships cotton, dairy products, peaches, strawberries and truck crops. The city has lumber and cotton mills, compresses, gins, foundries and mattress and box factories. It is the seat of Whitworth Junior College for Women. Brookhaven was settled in 1857. Brown Wells, noted for its mineral springs, is a popular nearby resort. Copiah-Lincoln Junior College is located nine mi. north of Brookhaven. Pop. 1920, 4,706; 1930, 5,288.

**BROOKINGS**, a city in eastern South Dakota, the county seat of Brookings Co., situated near the Sioux River, 60 mi. north of Sioux Falls. It is served by bus lines and the Chicago and North Western Railroad. The city is a shipping point for corn, oats, barley and potatoes, and the seat of the State College of Agriculture and Mechanic Arts, founded in 1881. The student body numbers about 1,300. Seven hundred acres of farm land are owned and used by the college for demonstration and experiments. The city was settled in 1870 and incorporated in 1883. Pop. 1920, 3,924; 1930, 4,376.

**BROOKINGS INSTITUTION**, located in Washington, D.C., an institution incorporated in 1927 to render public service through research work and training in the Humanistic Sciences. Its primary purposes are to aid constructively in the development of sound national policies, and to offer training of a supergraduate character to students of the social sciences. The Institute awards research fellowships, gives courses for staff members and provides library facilities for visiting scholars. Since its founding, it has published studies of tariff legislation, the St. Lawrence power project, changes in agriculture, international aspects of labor, and the success of unemployment insurance abroad. A board of trustees which is self-perpetuating assumes responsibility for the policies and program of work.

**BROOKLINE**, the largest municipality in Massachusetts still operating under town government, a detached part of Norfolk Co. It includes Brookline proper and sections of Longwood and Chestnut Hill, and is served by the Boston and Albany Railroad and electric and bus lines. Brookline is almost entirely residential. Manufactures are principally automobile bodies and scientific apparatus. In 1929 the value of the factory output was about \$2,500,000; the retail trade amounted to \$18,658,865. Until incorporation in 1705, Brookline was a part of Boston known as Muddy River Hamlet and remained in Suffolk Co. until 1793. Pop. 1920, 37,748; 1930, 47,490.

**BROOKLYN**, a borough of New York City constituting Kings County, N.Y., located in southwestern Long Island on the east side of the East River. It is connected with Manhattan by the Brooklyn, Manhattan and Williamsburg bridges, and by tunnels and ferries. A tunnel under construction will link it with Staten Island at the Narrows. The Interborough Rapid Transit, Brooklyn-Manhattan Transit, many elevated and surface lines, and the Long Island railroad afford transportation facilities. Brooklyn is an

important seaport and manufacturing center, with 36 mi. of improved waterfront, extensive docks and large warehouses. The Brooklyn Navy Yard is the largest in the world. Among the borough's diverse industries are, in the order of their value in 1927, boots and shoes, \$52,420,000; knit goods, \$49,738,000; paints and varnishes, \$48,214,000; foundry and machine shop products, \$44,380,000; meat packing, \$33,450,000; women's clothing, \$31,342,000; electrical machinery, \$30,570,000; furniture, \$29,194,000; men's clothing, \$27,489,000; ship and boat building, \$20,590,000; confectionery, \$17,450,000. In 1929 the total value of manufactured products was \$1,214,250,889.

Located in Brooklyn are the Brooklyn Museum, with rich collections of paintings, sculptures, and natural history and archeological objects, the Botanic Garden, containing many species of plants, the Academy of Music, Pratt Institute, Brooklyn Polytechnic Institute, several other colleges of the arts and sciences, and many churches and libraries. Of Brooklyn's numerous parks, the most important is Prospect Park covering 526 acres and laid out with a lake, ponds, gardens and playgrounds. Marine Park, with an area of 1,522 acres, is a comparatively recent development.

Brooklyn was first settled in 1636, its present name being taken from Breuckelen, a town in Holland. Among the historical events which have occurred in Brooklyn is the Battle of Long Island, fought on Aug. 27, 1776. It received a city charter in 1834, and became a borough of New York City in 1898. It is Greater New York's most populous borough. Pop. 1920, 2,018,356; 1930, 2,560,401. *See also* NEW YORK.

**BROOKS, PHILLIPS** (1835-93), American clergyman, was born in Boston, Dec. 13, 1835. He was graduated from Harvard, studied theology at an Episcopal seminary at Alexandria, Va., and was ordained priest in 1859. He began his rectorship in the Church of the Advent, Philadelphia. A man of imposing stature and appearance, compelling personality and uncommon eloquence, his influence was immediately felt. He championed Lincoln's cause during the Civil War. In 1869 he became rector of Trinity Church, Boston, near which now stands a bronze statue by Saint-Gaudens commemorating his service. He was consecrated Bishop of Massachusetts in 1891 and died at Boston Jan. 23, 1893.

**BROOKS, SAMUEL PALMER** (1863- ), American educator, was born at Milledgeville, Ga., Dec. 4, 1863. He took his A.B. at Baylor University in 1893, and his M.A. at Yale in 1902. In the latter year he became president of Baylor University. Brooks organized the Texas State Peace Congress, 1907, the first state organization of its kind in the United States; was president of the Baptist General Convention of Texas, 1914-17; and president of Southern Sociological Congress in 1915.

**BROOKS, VAN WYCK** (1886- ), American critic, was born at Plainfield, N.J., Feb. 16, 1886. He graduated at Harvard in 1907 and taught English at Stanford University in 1911-13. He worked for various publishing houses and was associate editor



of *The Freeman* in 1920-24. Among Brooks's writings are *America's Coming-of-Age*, 1915, *The Ordeal of Mark Twain*, 1920, *The Pilgrimage of Henry James*, 1925, and *Emerson and Others*, 1927.

**BROOKS, WILLIAM KEITH** (1848-1908), American zoölogist and educator, was born at Cleveland, O., March 25, 1848. He graduated from Williams College in 1870 and studied under Louis AGASSIZ at Harvard University until 1875. In 1876 he went to Johns Hopkins as associate in natural history. He became professor of zoölogy in 1883, of animal morphology in 1891 and head of the biological laboratory in 1893. His investigations of many classes of invertebrates were of distinction and widened knowledge of this class of life. In addition he was a gifted teacher and writer. Among his works were, *Handbook of invertebrate Zoölogy*, *Heredity* and *Foundations of Zoölogy*. He died at Baltimore, Md., Nov. 12, 1908.

**BROOM** (*Cytisus*), a group of profusely flowering, mostly shrubby but sometimes treelike plants of the pea family, comprising about 50 species native to the Old World, several of which are grown as ornamentals. The Scotch broom (*C. scoparius*), native to Europe and naturalized in the western United States, especially in California, is a deciduous shrub, with erect slender branches, bearing small leaves and showy, bright yellow, somewhat pealike flowers. Several varieties are in cultivation. The closely allied Spanish broom (*Spartium junceum*), native to Europe and widely planted, has slender, green, rushlike, almost leafless branches and large, fragrant, yellow flowers. The butcher's-broom (*Ruscus aculeatus*), a small European evergreen shrub, belongs to the lily family.

**BROOM CORN** (*Holcus Sorghum* var. *technicus*), a sturdy annual grass derived from the same botanical species as KAFIR, DURRA and the syrup SORGHUMS. Its seed is borne in loose panicles on long straight branches. These branches constitute the brush for which the plants are grown. Standard varieties grow 10 to 15 ft. tall with 18 to 30 in. brush, dwarfs, 4 to 6 ft. with 1 to 2 ft. brush. The former are used mainly to make carpet brooms, the latter for whisks.

Where climatic conditions are favorable broom corn may be grown in any soil suited to CORN (maize). Preparation of the ground is the same as for corn but planting is delayed until May and early June when the earth is warm, the surface being harrowed several times with a weeder before sowing. As dry weather during the ripening period is essential to the production of well-colored brush this crop cannot be grown profitably where autumn rains occur. Hence the crop has found a congenial home in Oklahoma, Kansas, the Panhandle section of Texas and the central Mississippi Valley.

Ripening of the seed makes the brush brittle; harvesting is done therefore when the blooming period closes. The cut brush is hauled to sheds where the crop is threshed, the worthless heads removed and the others dried rapidly out of sunlight to avoid bleaching. When thoroughly dry the brush is baled in 300 to 400 lb. bales for shipment. M. G. K.

# BROOM CORN PRODUCTION, U.S.

4-Year Average, 1927-30

Division	Acreage	Production (Tons)	% of Tot. Prod.
UNITED STATES .....	309,000	47,725	100.0
LEADING STATES:			
Oklahoma .....	133,000	18,950	39.7
Colorado .....	54,000	8,675	18.2
Kansas .....	45,000	7,675	16.1
Illinois ..	27,000	5,725	12.0
New Mexico .....	38,000	4,675	9.8
Texas .....	8,000	1,275	2.7

**BROOM RAPE** (*Orobanch*), the name given to a group of parasitic herbs of singular appearance, belonging to the broom rape family, found in the Old World and in North America. Destitute of green



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

YELLOW BROOM RAPE  
*Orobanch fasciculata*

foliage, these low, viscid, somewhat hairy parasites attach themselves to the roots of various other plants, sending up dull brownish, purplish, or whitish stems, bearing numerous bracts instead of leaves and many two-lipped yellowish or violet-purple flowers.

**BROTHERHOOD OF ST. ANDREW**, a men's brotherhood of the Protestant Episcopal Church, organized on St. Andrew's Day, 1883, was the pioneer of modern church brotherhoods. The purpose of the society is to pray for the extension of God's kingdom among young men and to induce its members to make a weekly effort to lead men nearer to God through the Church. Its headquarters are in Boston.

**BROTHERS KARAMAZOV, THE**, best known and probably the greatest of Dostoevski's novels; published 1879-80. (See also DOSTOIEVSKI, FEODOR.) A work of volcanic force, this is the story of the corrupt Feodor Pavlovitch Karamazov and his three sons, Ivan, Alexey and Dmitri. The old man is found



murdered, and Dmitri—between whom and his father the most rancorous jealousy is known to exist over a gypsy, Grushenka—is immediately suspected of the crime. After an involved trial the servant, Smerdykov, is finally convicted, Dmitri freed. Throughout the book there flashes a kind of intense and somber spirituality which is the essence of Dostoevski.

**BROUGHAM, HENRY PETER, BARON** (1778-1868), was born at Edinburgh, Sept. 10, 1778. He was graduated from the Edinburgh University and in 1800 was admitted to the Scottish Bar. In 1802 he became one of the founders and editors of the *Edinburgh Review*, to which he contributed 80 articles. In 1808 Brougham joined the English Bar; in 1810 he became a member of Parliament and became leader of the Liberal Party; in 1820-21, as her attorney-general, he secured the acquittal of Queen Caroline. In 1830 he became lord high chancellor of England, and after his resignation in 1834, he devoted the rest of his life to the study of science and literature. He died in Cannes, France, May 7, 1868.

**BROWN, HEYWOOD CAMPBELL** (1888- ), American journalist, was born in Brooklyn, N.Y., Dec. 7, 1888. He studied at Harvard and took up newspaper work in New York City, serving on the *Morning Telegraph*, 1910-12, the *Tribune*, 1912-21, the *World*, 1921-28, and later continued his well-known column, *It Seems to Me*, in the Scripps-Howard papers. Among Brown's publications are *A.E.F.—With General Pershing and American Forces*, 1918, *Seeing Things at Night*, *The Boy Grew Older*, 1922, and, with Margaret Leech, *Anthony Comstock*, 1927. In 1930 Brown was a candidate for Congress on the Socialist ticket, but was defeated. He produced a revue, *Shoot the Works*, in New York City, 1931.

**BROWN, CHARLES BROCKDEN** (1771-1810), American novelist, was born at Philadelphia, Pa., Jan. 17, 1771. He was the first distinctively American novelist, writing of the Indians before Cooper, and delving into mysticism and morbid psychology before Poe and Hawthorne. He developed weird but logical plots. Among his best known novels are *Wieland, or the Transformation*, *Arthur Mervyn*, and *Ormond*. In *Arthur Mervyn* is a graphic description of the yellow fever epidemic in Philadelphia, and *Ormond* won Percy Bysshe Shelley's admiration. Brown died in Philadelphia, Pa., Feb. 22, 1810.

**BROWN, ELMER ELLSWORTH** (1861- ), American educator, was born at Kiantone, N.Y., 1861. He graduated from the University of Michigan in 1889, the next year studied in Germany, and in 1893 became professor of education at the University of California. In 1896 he was appointed United States Commissioner of Education, resigning in 1911 to become chancellor of New York University. Brown resigned from this office in June 1932.

**BROWN, FORD MADDOX** (1821-93), British painter, was born at Calais, France, Apr. 16, 1821. His artistic foundations were laid in the art centers of Belgium, but he studied also in Paris and Rome. On settling in London he had Rossetti as a pupil and

formed close associations with the Pre-Raphaelites, though he was never actually a member of this group. His striking individualism was shown in *Lea and Cordelia*, exhibited in 1846. Other well-known works are *Christ Washing St. Peter's Feet* in the Tate Gallery, London, and the realistic *Work* in the Manchester Gallery. Brown cooperated with William Morris in the decorative arts, notably in stained-glass design. His last years were occupied with the decoration of the Manchester Town Hall by a historical series going back to Roman days. The artist died in London, Oct. 6, 1893.

**BROWN, GEORGE** (1818-80), Canadian journalist and statesman, was born at Edinburgh, Scotland, Nov. 29, 1818. He came to New York with his father in 1838, moving to Toronto five years later. In 1844 he founded the *Toronto Globe*, published daily after 1852, which wielded tremendous influence. As editor and as a member of Parliament, he fought the Roman Catholic Church, sectarian schools, and assailed the disproportionately large representation of French-Canadians in Parliament. In 1864, with affairs in Parliament at a deadlock, he accepted the suggestion of the governor-general, Lord Monck, of a Macdonald-Brown coalition to advance the movement for federation of the provinces in Canada, although JOHN A. MACDONALD was his personal enemy. Even after defeat in the election of 1867, he continued his vigorous advocacy of westward expansion, favoring the acquisition of the northwest provinces. In 1873 he was elected to the Senate, and the following year was appointed with Sir Edward Thornton to represent Canada, on a reciprocity treaty with the United States, which was later killed by the U.S. Senate. He died May 9, 1880.

**BROWN, HENRY KIRKE** (1814-86), American sculptor, was born in Leyden, Mass., Feb. 24, 1814. He studied painting in Boston in 1832, and established himself as a portrait painter in Cincinnati in 1836. Brown modeled his first head in clay in that city and became so fascinated with that medium that he turned from painting to sculpture. In 1837 he produced his first bust in marble, an ideal female head. He went to Italy in 1842, and studied there for four years, producing among other things, his *Ruth*, and *Boy and Dog*, now belonging to the New York Historical Society. On his return to New York in 1846, he established a studio there and soon won renown. His highest achievement is the equestrian statue of Washington in Union Square, New York. He also has two equestrian statues in Washington, one portraying Gen. Winfield Scott, and the other, Gen. Nathanael Greene. Brown died at Newburgh on the Hudson, July 7, 1886.

**BROWN, JOHN** (1800-59), American abolitionist, was born at Torrington, Conn., May 9, 1800. His mother, and also her mother, died insane, and his own sanity was questioned in later years. In his youth he was a tanner and later engaged in sheep raising. His hatred of slavery was early fixed, and in his fanatical mind he visioned himself as divinely appointed

to end the evil institution by force. He lived in several states before moving to Kansas in 1855 which, with the passage of the Kansas-Nebraska Act of 1854, had become a storm-center of the slavery problem. In retaliation for the attack upon the "Free-State" settlement of Lawrence, he, his four sons, and one other man, on May 25, 1856, massacred five defenseless pro-slavery men. Later he obtained funds in the East for the support of his abolitionist work, and there is evidence that prominent northeastern abolitionists who contributed were aware of the way in which the money was to be used. In 1858 in Canada, he drew up a plan for a new "provisional constitution and ordinance" for the United States. After traveling again to Kansas, he went to Harpers Ferry, Va., and on the night of Oct. 16, 1859, with 22 companions, he attacked and captured a United States arsenal there. He planned by this bold act to incite the slaves to insurrection and hoped thus to end slavery in the South. Two days later the raiders were themselves overpowered by a company of marines commanded by Col. Robert E. Lee. With his surviving companions, John Brown was tried for treason, conspiracy and murder, Oct. 27-31, and convicted. He was hanged at Charleston, Va. (now W. Va.) Dec. 2, 1859.

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**BROWN, ROBERT** (1773-1858), British botanist. In 1801 he joined as naturalist an expedition to Australia, and returned with several hundred plants, many of them unknown. He set to work on their classification and in 1810 published the first thorough study of the Australasian flora. His adoption of the botanical nomenclature of the French naturalists Jussieu helped to replace the Linnæan system. Brown's great botanical discovery was the distinction between **ANGIOSPERMS** and **GYMNOSPERMS**. He likewise discovered the irregular ceaseless motion of particles in suspension, the Brownian Movement which proved of vast consequence in modern physics. In 1827 Brown became keeper of the botanical department of the British Museum and from 1849 to 1853 President of the Linnæan Society. Brown was born at Montrose, Scotland, Dec. 21, 1773 and died in London, June 10, 1858.

**BROWN, WILLIAM HARVEY** (1862-1913), American zoölogist, was born at Des Moines, Ia., Aug. 22, 1862. He graduated from the University of Kansas and joined the staff of the Smithsonian Institution which he represented in 1889 on the United States government eclipse expedition to the Congo country. For four years he explored and collected, and then, as a citizen of the colony known as Rhodesia, helped develop agriculture and mining. He is the author of *On the South African Frontier*, a history of Rhodesia. His extensive zoölogical collections are housed in museums at Cape Town, Washington and Pittsburgh. He died April 24, 1913.

**BROWN COAL**, a term used by the United States Geological Survey to designate materials in the first

stages of **COAL** formation, **PEAT** and **LIGNITE**, because of their predominantly brown color. The German braunkohle, or brown coal, frequently highly bituminous, is considered to be a stage intermediate between peat and lignite. *See also* **JET**.

**BROWNE, CHARLES FARRAR** (1834-67), American humorist who wrote under the pen name of Artemus Ward, was born near Waterford, Me., Apr. 26, 1834. He learned the printer's trade and worked his way as far west as Cleveland, where the first of his famous Artemus Ward series was published in *The Plain Dealer*, 1858. This imaginary character, Artemus Ward, a shrewd but uneducated traveling showman, became extremely popular, and the sketches were collected in book form: *Artemus Ward, His Book*, 1862, *Artemus Ward, His Travels*, 1865, *Artemus Ward in London*, 1867, *Artemus Ward's Lecture*. Browne died in England, Mar. 6, 1867.

**BROWNE, SIR THOMAS** (1605-1682), English physician and writer. He was a graduate of Oxford, travelled in Europe and attended lectures at the universities of Padua and Montpellier, and was made doctor of medicine by the University of Leyden (1633). He settled as a physician in Norwich in 1637. He is noted particularly for his writing of the *Religio Medici* (published, 1642-43), which has been characterized as an attempt to "reconcile skepticism with faith." The book was the favorite volume of Sir William Osler and of many other famous persons. He died at Norwich, having achieved considerable literary fame.

**BROWNE, WILLIAM** (1591-1643), English poet, noted for his pastorals, was born at Tavistock, Devonshire in 1591, and was admitted to the Inner Temple in 1611. His first book of *Britannia's Pastorals* was published in 1613, followed in 1614 by the *Shepherd's Pipe*. After publishing the second book of the *Pastorals* in 1616, Browne retired to private life. His poems are read and enjoyed because of the truthful pictures of his native Devonshire and the surrounding country. The third book of *Britannia's Pastorals* was edited from a manuscript by T. C. Croker in 1852.

**BROWNELL, WILLIAM CRARY** (1851-1928), American critic, was born in New York City, Aug. 30, 1851, and graduated at Amherst in 1871. In 1879-81 he served as art critic for *The Nation* and, in 1890 became literary adviser for Charles Scribner's Sons. He was called the last of the Victorians and his critical writings, including *American Prose Writers* and *French Traits and Standards*, done in the traditional classical manner, were accepted as final judgments. He was elected a member of the American Academy of Arts and Letters and his last book, *Democratic Distinction in America*, was published in 1927. Brownell died at Williamstown, Mass., July 22, 1928.

**BROWN-EYED SUSAN** (*Rudbeckia triloba*), a handsome biennial of the composite family native to the eastern United States and much planted, as an annual, in gardens for its showy flowers. It grows

2 to 5 ft. high bearing bright green, usually smooth foliage and attractive flower-heads, about 2 in. across, composed of deep yellow rays, often with an orange or brownish base, surrounding a central black-purple disk.

**BROWNIAN MOVEMENTS**, the extremely minute movements of small particles suspended in a fluid, as, e.g., smoke particles in the air, called such after R. BROWN who first observed them in 1827. If one examines the particles in a cloud of smoke from a cigarette by means of a low-powered microscope, he finds that after all apparent movements, such as convection currents, have ceased, there is left a continual to and fro motion of all the particles. This movement is extremely erratic, being full of sudden turns, twists and variations in velocity. These Brownian movements offer a convincing argument for the existence of the movements of still smaller, invisible particles called MOLECULES. The random motion of the comparatively large Brownian particles is the result of a continued bombardment on all sides by the small but numerous molecules. At any given instant, the forces of the molecules striking one side are greater than those striking the other side. These unbalanced forces give motion to the particle, and they change continually so that the particle executes a tortuous path.

Brownian movements prevent the molecules of the air above the earth's surface, and of COLLOIDS in their suspensions, from falling downward under the influence of gravity. Since the particles are more numerous at the lower levels, the molecular-collision forces are continually knocking a larger number upward than downward. The excess number moving up is equal to the number falling under the pull of gravity. An equilibrium condition is thus established.

For a given kind of particle in a given kind of supporting fluid, the displacement,  $x$ , of the particle, observed in a horizontal plane when equilibrium has been established, depends on the length of time,  $t$ , the particle is under observation. EINSTEIN has established a precise relationship. This equation,

$$\frac{x^2}{t} = \frac{RT}{3\pi N\eta a}$$

has been carefully tested and found to be true in all particulars. In this equation,  $R$ ,  $N$  and  $n$  are properties of the gas, i.e., the gas constant, AVOGADRO'S CONSTANT and the VISCOSITY, respectively;  $T$  is the absolute temperature and  $a$ , the radius of the particle (of the order of .001 mm.). Thus, the horizontal displacement per second,  $x$ , depends on the nature of gas, the absolute temperature and the radius of the particle. The hotter the gas the greater will be the average displacement of the particle. The movement of the particle does not depend on the kind of material of which it is made but on its size, the smaller particles moving the greater distances. J. B. H.

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**BROWNING, ELIZABETH BARRETT** (1806-61), English poet, was born at Durham, Feb. 10, 1806, but grew up at Hope End, in Herefordshire. She

began to write early, and even, at the age of 11, attempted a long epic poem, *The Battle of Marathon*. A fall from her pony affected her spine and she became a partial invalid throughout her life. She was an ardent student, particularly of Latin and Greek. In 1833 she published a translation of *Prometheus Bound* with some original poems. In 1838 her *Seraphim and Other Poems* appeared, followed in 1844 by *Poems*. Through this latter book Elizabeth Barrett's correspondence and friendship with ROBERT BROWNING began. In 1846 she married him secretly—her father having forbidden his daughters to marry—and went to Italy where, except for visits to England, she lived for the rest of her life. Her *Sonnets from the Portuguese*, first published in 1847 as *Sonnets by E.B.B.*, gave expression to her love for the poet and her reluctance to burden him with an invalid wife. New editions of her poems were published in 1850 and 1853, and in 1856 her *Aurora Leigh* appeared; four editions were brought out in quick succession. Elizabeth Browning ranks high as a poet, her emotionalism being well-tempered by her intellectual power. She died in Florence, June 30, 1861, and was buried there.

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**BROWNING, JOHN M.** (1855-1926), American inventor, was born in Ogden, Utah. At the age of thirteen he made his first gun in his father's gunshop. He secured patents for a breech-loading rifle, 1879; a repeating rifle, 1884; a box magazine, 1895; and numerous other patents on rapid-fire guns. His automatic guns were used by the United States and various European governments.

**BROWNING, ROBERT** (1812-89), English poet, was born at Camberwell, London, May 7, 1812. At 14 he was reading Shelley and Keats, and though he attended London University his true education consisted in following his poetic bent. After leaving college he went abroad, making his first visit to Italy in 1834. Fame came to him slowly; *Pauline*, published in 1833, was followed by *Porphyrion's Lover*, *Paracelsus*, 1835, and *Sordello*, 1840. *Stratford*, his first drama, was produced in 1837, Macready playing the leading part. Then came the ripening fruits of genius: *Bells and Pomegranates*, issued from 1841-46, included "Pippa Passes" and "The Bishop Orders His Tomb in St. Praxed's Church." Several well-known lyrics and four tragedies also belong to this period. Among the former are *The Pied Piper* and *The Lost Leader*, among the latter, *A Blot on the 'Scutcheon* and *Luria*.

Browning's marriage to Elizabeth Barrett (see BROWNING, ELIZABETH BARRETT) took place Sept. 12, 1846. The story of that romance, though so often told, yet bears repetition. Attracted by Miss Barrett's poems, Browning sought an interview, and the acquaintance grew to love. Though Miss Barrett was an invalid, and though her father was determined none of his children should marry, Browning overcame all obstacles and carried his wife away to Italy,

where the two lived for 15 years, mostly at the Casa Guidi, Florence. Among the works which appeared during this period are *Christmas Eve and Easter Day* and the notable *Men and Women*, in which many famous poems appear.

After his wife's death, 1861, Browning returned to London, and the deepening of life's experience was expressed in many noble works. *Dramatis Personae*, 1864, contains among its dramatic monologues, "Rabbi Ben Ezra," "Abt Vogler" and "A Death in the Desert." In 1869 *THE RING AND THE BOOK* appeared; this work, which consists of the story of a murder told 12 times by different persons, is generally held to give the poet's genius and experience their crowning expression. The principal production of Browning's later years was *Asolando*, published in 1889, when the poet was dying.

The psychological subtleties which often obscured Browning's meaning, as well as certain peculiarities of style, delayed the full recognition of his genius. But he found his place as one of the most robust and constructive of modern poets. At his best he escapes into the upper realms of lyric beauty, even ecstasy. Love and sorrow in turn moulded his genius; its fruit is rich, solid, and full of the wine of life. Browning died at Venice, Italy, Dec. 12, 1889. See also ENGLISH LITERATURE.

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**BROWN-SÉQUARD, CHARLES EDOUARD** (1817-1894), French-American physiologist and neurologist, was born in Mauritius, the son of an American father and a French mother. He was at various times in London, Paris, and New York. He was professor in the Harvard (1864-1868) and Paris (1869-1873) medical faculties, and succeeded Claude Bernard as professor of experimental medicine in the Collège de France in 1878. He is widely known for his experimental investigations in the field of physiology, and especially through his study of the glands of internal secretion. He died at Sceaux, April 2, 1894.

**BROWNSTONE.** See SANDSTONE.

**BROWNSVILLE**, a city in southernmost Texas, the county seat of Cameron Co. It is situated on the Rio Grande approximately 20 mi. from the Gulf of Mexico. Four railroads, two international bridges, a deep water port and an airport afford transportation facilities. The site was settled in 1772, when a grant of land was given to José Salvador de la Garza by Spain. In 1846 Gen. Zachary Taylor took possession of the settlement, then under Mexican rule, and fortified it. This garrison was attacked by Mexicans and gallantly defended by Maj. Jacob Brown, for whom the fort, still in use, and the city were afterwards named. The last battle of the Civil War was won by the Confederacy near Brownsville, more than a month after peace had been declared. Snakeville, an internationally known establishment dealing in wild animals, is part of the city. Cotton, citrus fruits and vegetables are

produced in the vicinity. In 1929 the value of the local factory output was about \$1,000,000; the retail trade, \$9,607,616. Pop. 1920, 11,791; 1930, 22,021.

**BROWN-TAIL MOTH**, a moth of the family *Lymantriidae*, accidentally imported from Europe. Larvæ hatch in August and skeletonize the leaves of many species of trees and shrubs, but do not attack conifers. In the fall they weave winter nests of silk and leaves at the tips of branches, in each of which nests several hundred larvæ hibernate. In early spring they emerge and destroy foliage. Adult insects are white except for the yellowish-brown abdomen, which at the tip bears a tuft of hairs which is most conspicuous in the female. Venomous barbed hairs covering the body of the larva cause brown-tail rash on the skin of man. These hairs break off from the cast skins of larvæ and are wind-borne. They are also shed out of the old cocoons. Collecting and burning the nests in winter and spraying with lead arsenate in early fall are effective. The brown-tail is not as serious a pest now as the gypsy moth.

**BROWN UNIVERSITY**, Providence, R.I., a non-sectarian institution of higher learning for men and women founded through Baptist influence. Brown was the seventh college in the colonies, being chartered as Rhode Island College in 1764. In 1804, the name was changed to Brown University in honor of Nicholas Brown, a benefactor. The university includes the Liberal College for men, PEMBROKE COLLEGE for women, and engineering and graduate divisions. The productive funds in 1931 for the men's college totaled \$9,746,335; for the women's college, \$541,594. The library of 423,000 volumes contains the 42,000-volume Harris Collection of American poetry. In 1931-32 there were 1,272 students exclusive of Pembroke College, and a faculty of 163, headed by Pres. Clarence A. Barbour.

**BROWNWOOD**, a city of central Texas, the county seat of Brown Co., situated on the Atchison, Topeka and Santa Fe and the Fort Worth and Rio Grande railroads, 140 mi. northwest of Austin. It is the seat of Daniel Baker College and Howard Payne College. Brownwood is in a rich agricultural region, and throughout the year makes large shipments of pecans, vegetables, wool, dairy products, poultry, cattle and cotton. Coal mines and oil wells are located here, as are also cotton ginning establishments and flour mills. In 1929 the retail trade reached a total value of \$10,062,160. Cattle trading is extensively carried on in Brownwood. Pop. 1920, 8,223; 1930, 12,789.

**BRUCE, ROBERT** (Robert I) (1274-1329), King of Scotland, was born on July 11, 1274. He renounced his loyalty to EDWARD I of England, in 1296, as the Earl of Carrick, and joined his followers to liberate Scotland. The next year he made peace with Edward, and in 1299 was appointed one of four regents to rule Scotland in the name of the Baliol line. In 1306 Bruce engaged in a quarrel with John Comyn, Baliol heir to the Scottish throne, and stabbed him to death. He then proclaimed himself king. The same year the English advanced against him,

and Bruce was forced to flee. His estates were seized, and many of his supporters hanged. In 1307 Bruce came out of hiding, and with only a small force defeated the English at Loudon Hill. In the next two years he won back almost all of Scotland, and expelled the English. In 1314 Bruce again defeated the English at the celebrated battle of **BANNOCKBURN**. He made an expedition to Ireland in 1317 to aid Edward, his brother, and helped to defeat the English and Irish forces. A truce between England and Scotland, drawn in 1323, ended for 13 years further hostilities, except for an abortive attempt in 1327 by **EDWARD III** to invade Bruce's kingdom. Stricken by leprosy, Bruce retired to Cardross Castle, Scotland, in 1327, and died on June 7, 1329.

**BIBLIOGRAPHY.**—H. E. Maxwell, *Robert the Bruce*.

**BRUCE, STANLEY MELBOURNE** (1883- ), Australian statesman, was born in Melbourne, Apr. 15, 1883. He was educated at Cambridge University, practiced law in London for several years and served in the World War in 1914-17, after which he returned to Australia and entered politics as a member of the Liberal faction of the National party. In 1921 he represented the Commonwealth at the League of Nations Assembly, and in 1926 at the Imperial Conference, London. He was prime minister of Australia from 1923-29.

**BRUCH, MAX** (1838-1920), German composer, was born at Cologne, Jan. 6, 1838. In 1852 he was awarded a Mozart Foundation scholarship at Frankfurt, where he studied until 1856. His opera *Loreley* was given at Mannheim in 1863. During 1880-83 he lived in England, conducting the Liverpool Philharmonic Society, which he left to become director of the Orchesterverein at Breslau. He was one of the greatest technicians of his age, with a strong leaning to folk-song, especially Hebrew traditional melodies. His violin concertos, notably the *Kol Nidrei*, enjoy modern popularity. He died at Friedenau, Oct. 2, 1920.

**BRUCITE**, sometimes called native magnesia, a natural magnesium hydroxide occurring in transparent to translucent rhombohedral crystal plates of white to pale green in color; also fibrous granular and massive. It accompanies other magnesian minerals in serpentine and is sometimes found in limestone. Localities where it has been noticed are in New Jersey, New York, the Shetland Isles and in Sweden. Brucite is named after A. Bruce, early American mineralogist.

**BRUCKNER, ANTON** (1824-96), Austrian composer and organist, was born at Ansfelden, Sept. 4, 1824. He was a chorister and studied at St. Florian. He continued his studies at Vienna, where he was appointed organist at the Hofkapelle, and later professor at the Conservatorium. In 1871 he gave a series of organ recitals at London. His renown rests chiefly on his eight symphonies, written between 1866 and 1892. His style was somewhat influenced by **WAGNER**. The slow movement of his seventh symphony was written as an elegy on the death of Wagner. He died at Vienna, Oct. 11, 1896.

**BRUEGHEL** or **BREUGHEL**, the name of a noted family of Flemish painters. Peeter Brueghel (c.1525-c.1570), the Elder, was born at Brueghel, near Breda, about 1525. He became master of the Antwerp painters' guild in 1551, and not long after went to Italy. Upon his return he lived at Antwerp, and settled at Brussels after 1563, where he died about seven years later. He is noted chiefly for his peasant scenes which are marked by realism and often by a coarse humor.

Peeter Brueghel (1564-c.1637), the Younger, was born at Brussels in 1564. His paintings, which deal with fantastic scenes of ghosts and devils, were inferior to those of his father, Peeter Brueghel the Elder. He died at Antwerp about 1637.

Jan Brueghel (1568-1625), called "Velvet" Brueghel, was born at Brussels in 1568, the son of Peeter Brueghel the Elder. After traveling in Italy, he lived in Antwerp, where he became dean of the guild in 1602. His paintings for the most part portray landscapes, animals and genre subjects. They are characterized by excellent finish, realism and brilliant color. Brueghel was highly valued by his contemporaries and exercised considerable influence in art. He died at Antwerp, Jan. 13, 1625.

Jan Brueghel (1601-77), the Younger, was born at Antwerp and baptized in Sept. 1601. He visited Italy, returning in 1625. He was greatly influenced by his father, "Velvet" Brueghel, and his work is frequently attributed to the latter. He died about 1677.

**BRUENING, HEINRICH** (1885- ), German statesman, appointed Chancellor of the Reich in Mar. 1930. Bruening received his early training in law at the University of Munich, in history and literature at Strasburg, and in political science at Munster and Bonn Universities. From 1915 to 1918 Bruening served as an officer on the Western Front. At the close of the war he became a Catholic social worker at Dr. Sonnenschein's Welfare Institute. Bruening's next post was that of secretary to Stegerwald, founder of the Catholic Trade Union movement; in 1921 when Stegerwald became Prussian Prime Minister, Bruening took over the management of the Catholic trade unions and retained the position until 1930. In 1921 also, Bruening founded and partly edited a union daily, *Der Deutsche*.

The political career of Heinrich Bruening began with his election as member of the Reichstag in 1924. There he soon became a prominent member of the taxation committee. In 1929 he succeeded Stegerwald as head of the parliamentary Zentrums-Partie or Catholic Centrist Party. After the resignation of Müller in 1930, Bruening was appointed Reich Chancellor and by Sept. 1930, had procured a dissolution of the Reichstag and new elections. In Mar. 1931, when the need for drastic governmental economy became evident, Bruening assumed the power of governing Germany by emergency measures issued by the President of the Reich, under the provisions of Article 48 of the Weimar Constitution.

During 1931 Bruening conferred with foreign envoys on war debts, and visited London, Paris and



Rome in the interests of international cooperation to lessen economic difficulties. The proposed Austro-German customs pact found an advocate in the Reich Chancellor, who held that it did not violate the Geneva Protocol of 1922 and was therefore no concern of the League of Nations. In 1932, Bruening headed the German delegation to the Disarmament Conference at Geneva. Ascetic and scholarly, lacking the fiery appeal of his chief enemy, the Fascist Adolf Hitler, Dr. Bruening as a political figure nevertheless gained the confidence of a large part of the German people. Only six years after entering the Reichstag, he had risen to the Chancellorship of the Reich and become the outstanding leader of the German moderates. President Von Hindenburg forced Bruening's Ministry to resign May 30, 1932.

**BRUGES**, a town in Belgium, the capital of the province of West Flanders, located about 6 mi. from the North Sea. The great days of Bruges were in the Middle Ages, when it was a member of the HANSEATIC LEAGUE, and a flourishing commercial center. The belfry, chiefly celebrated because of its chimes, was built in the late 13th century, and is attached to the 16th-century market-hall on the Grande Place. The Hotel de Ville, dating from the 14th century, the 13th-century church of St. Sauveur and the 14th-century church of Notre Dame are outstanding examples of Gothic architecture. The principal paintings by Hans Memling are in the old Hôpital St. Jean. The vistas of the old quays, canals with their many bridges and ancient houses now attract artists and travelers. During the World War the town was occupied by the Germans, who maintained a submarine base nearby at Zeebrugge. The manufacture of lace is an important industry. Pop. 1930, 51,220.

**BRUGES CANAL**, in Belgium, constituting a link between the city of Bruges and the harbor of Zeebrugge on the North Sea. It is over 6 mi. long, 72 ft. wide at the bottom, 229 ft. wide at the surface, and 28 ft. deep. It runs at sea level throughout its entire course. Ships of 25 ft. draft are permitted to pass through the canal to reach the wharves of the city. Construction of the canal began in 1896 and was completed 11 years later.

**BRULÉ, ÉTIENNE** (?-1633), French explorer, was one of the first settlers of Quebec, Canada, and was delivered in 1610 to the Huron Indians, by SAMUEL DE CHAMPLAIN, in an exchange of hostages. Brulé later explored northern New York, Province of Ontario, and the copper mines of Lake Superior. He was killed by the Huron Indians in 1633.

**BRULE**, a sub-group of the great Teton division of the Siouan Dakota. Their name is the French translation of the name by which they called themselves, meaning "burnt thighs." The Brule are themselves classified in three major divisions: the Upper Brule, now living on Rosebud Reservation in South Dakota, the Lower Brule, at Crow Creek Agency and the Brule of the Platte River. Formerly they occupied the east side of the Missouri from the mouth of the White River to the Teton, where they lived in tipis,

hunted the buffalo and made periodical raids for horses and war expeditions against the Pawnee and Arikara. Their former nomadic existence has long been abandoned and on the reservations their chief occupations are stock-raising and farming.

**BRUM, BALTASAR** (1883- ), Uruguayan statesman and newspaperman. In 1913 he became minister of education, and in this position reformed the entire educational system of Uruguay. He distinguished himself as an advocate of the National Council of Administration to share the executive power with the President of the Republic, embodied in the Constitution in 1918; he served as minister of interior and of foreign affairs, and in the latter capacity oriented the external politics of Uruguay toward arbitration of all difficulties, even those touching national honor. He became president in 1919-23 and during his term made notable reforms in the internal and external affairs of Uruguay. His writings have been extensive, the most important being *La Doctrine del arbitraje amplio* and *La paz de America*.

**BRUMMELL, GEORGE BRYAN** (1778-1840), known as *Beau Brummell*, English traditional gentleman, was born in London, June 7, 1778. He went to Eton, where he became acquainted with the Prince of Wales, afterward George IV. Popular, a dandy and wit, young Brummell on leaving Oxford became the Prince's friend and protégé, and having succeeded to a fair fortune won distinction as dictator of fashion and elegance, London's most celebrated man-of-the-world. After some years Brummell lost his wealth and in 1816 left England to escape his debts. He lived 14 years at Calais, then held the post of British consul at Caen from 1830 to 1832. He was confined in prison for his debts in 1835. Sunk into poverty, stricken by paralysis, he died in a charitable institution at Caen, Mar. 30, 1840.

**BRUNDISIUM** or **BRUNDUSIUM**, an ancient city of Calabria, the modern BRINDISI. It was located on the Adriatic, 44 mi. from Tarentum and took its name from the shape of its harbor, the form of which resembled a stag's head. Founded by the Sallentines in 267 B.C., it was an unimportant city until the Romans recognized its strategic location, and in 244 B.C. they colonized it. Its inner and outer harbor made its defense fairly easy so that it became an important naval station as well as a center for the passage of troops. It played a leading part in the Illyrian war of 230 B.C. and was the scene of a number of historical events, being an objective of HANNIBAL and having received Sulla in 83 B.C. and Cicero in 57 B.C.

**BRUNEI**, capital and largest city of the British protectorate of Brunei, in the northwest part of Borneo. It is situated on the Brunei River, about 15 mi. from its mouth. There are no important buildings, even the palace of the sultan of Brunei being a mere collection of barns. The industries include boat building, brass foundries and the weaving of cloth. Silverware is also manufactured. Pop. 1921, 12,000.

**BRUNELLESCHI, FILIPPO** (1379-1446), Florentine architect, began life as a goldsmith and sculp-

tor. He lost the commission for the doors of the Florentine Baptistery (1401) and went to Rome. Brunelleschi was the reviver of the classic style in Italy and especially at Florence, where his severely elegant style is seen in the churches of San Lorenzo and Santo Spirito, the Pitti Palace and the Capella del Pazzi. His masterpiece is the beautiful dome of the Cathedral of Florence (Santa Maria del Fiore). He died at Florence, April 16, 1446.

**BRUNETIÈRE, FERDINAND** (1849-1906), French critic, was born in Toulon, July 19, 1849. Educated at Marseilles and the Lycée Louis-le-Grand, Paris, he received recognition for his scholarship in appointment to a professorship at the École Normale, Paris, in 1886, without further academic training. In 1887 he was decorated by the Legion of Honor. In 1893 Brunetière was made editor-in-chief of the *Revue des Deux Mondes*, and also lecturer at the Sorbonne, and in the same year became a member of the French Academy. He lectured in the United States in 1897. Conservative, anti-materialistic, unwaveringly courageous, he was one of the greatest of modern French critics. Among his best known works are the *Études Critiques*, 1880-98, *Histoire et Littérature*, 1884-86, and *Questions de Critique*, two series, 1888-90. Brunetière died in Paris, Dec. 9, 1906.

**BRUNHILD or BRUNHILDA**, in Scandinavian mythology, a Valkyrie, daughter of ODIN. Her father, in punishment for disobedience, put her to sleep on the rock of Hendarfjell, surrounded by a wall of fire. She could be awakened only by a hero who dared to pass through this wall for her sake. In the *Nibelungenlied* she was the Queen of Iceland, whom Siegfried (see SIGURD) wooed for the King of Burgundy. In the *Volsungasaga* she was the victim of her hopeless love for SIGURD. She brought about his death and threw herself on his funeral pyre that she might be united to him in the world of the dead.

**BRUNHILDA** (d. 613), a Visigothic princess, in 566 married Sigebert, King of Austrasia. Her younger sister, Galswintha, married his brother Chilperic, King of Neustria. Chilperic's love for his former concubine, Fredegonda, led to the murder of Galswintha and started a family feud of which Brunhilda was the center and which lasted until her death, tied to the heels of a wild horse. Brunhilda was a truly heroic figure. After the death of Sigebert she married the son of her enemy Chilperic, ruled for her son and her grandsons, and it was only upon their death that the Austrasian nobles rose against her. She was an able and forceful woman, much respected by Pope Gregory the Great, some of whose letters to her are still extant, and cordially hated by the missionary monk, Columbanus, whom she persecuted because he refused to bless her illegitimate grandsons.

**BRÜNN.** See BRNO.

**BRUNO, ST.** (1030-1101), missionary and ecclesiastic, was born at Cologne in 1030. After serving for some time as canon of Rheims and as director of the schools of the diocese, he retired to the desert near Grenoble and founded the Carthusian Order.

(See CARTHUSIANS.) After founding a second Carthusian monastery at Della Torre in Calabria, 1094, he died there in 1101. He was canonized in 1628, his feast day being set on Oct. 6.

**BRUNO, GIORDANO** (1548-1600), Italian philosopher, was born at Nola, near Naples, in 1548. In 1563 he became a Dominican but left the monastery in 1576. He traveled about from place to place, spending some time at Geneva, Paris, England and Germany. Finally he settled in Venice in 1592, but the following year became a victim of the Inquisition. After spending seven years in prison he was burned at the stake as a heretic in Rome, Feb. 17, 1600.

Bruno was the first influential metaphysician of the 16th century to accept the Copernican (see COPERNICUS, NICOLAS) theory. Because of his spirit and the fact that in him may be found the germs of ideas later developed, modern philosophy is sometimes said to start with him. Among such ideas may be noted the distinction between *Natura Naturans* and *Natura Naturata*, developed by BARUCH SPINOZA, and the theory of the monad, developed by GOTTFRIED LEIBNITZ. Although regarded as an atheist in his day, like Spinoza, Bruno was a thoroughgoing pantheist.

**BRUNO OF QUERFURT, ST.** (c. 975-1009), also known as Saint Boniface, missionary and martyr, Bishop of Prague and the Apostle of Livonia and the West of Russia, was born in Saxony about 975, a relative of the Emperor Otto III. Filled with proselytizing zeal, he undertook the task of evangelizing the northern countries. His preaching in Poland and Russia proper was eminently successful and he made many converts. But, having pushed too far inland into heathen Lithuania, Bruno and all his followers were massacred, Feb. 14, 1009. His feast is kept on June 19.

**BRUNSWICK or BRAUNSCHWEIG**, a free state in northwestern Germany. It is divided into three large parts, surrounded mostly by the Prussian provinces of Saxony and Hanover, and six small scattered districts. The southern portions are mountainous and wooded, while the northern sections are in the North German Plain. The Weser drains almost all of the state. The total area is 1,424 sq. mi.; pop. 1925, 501,875.

The cultivation of vegetables for city markets and of sugar-beets and grain is important. However, since the discovery of potash salts and brown coal in the Harz foreland, the economic situation is changing.

The city of Brunswick is the capital of the state of Brunswick; it is located about 50 mi. north and west of Magdeburg on the Oker River. It developed around the castle founded in 861 and the cathedral of 1173 in the shape of five independent settlements, which gave the old city its irregular character. Notable buildings include interesting churches, the Gothic rathaus and the Gothic and Renaissance houses, many finely carved. The chief industry is the building of mills and machinery, optical wares, canned goods and other food products. Books are the chief article of trade. Schools, libraries, and museums contribute to

the cultural needs, as do the subsidized opera and theater. Pop. 1925, 146,725.

**BRUNSWICK**, a city in southeastern Georgia, the county seat of Glynn Co., situated on a land-locked harbor in Oglethorpe Bay, 8 mi. from the Atlantic Ocean. Three railroads, bus and truck lines and freight steamers serve the city. Truck farming is the chief industry of the vicinity. Canned sea food, gasoline and naval stores are the principal manufactures. In 1929 the factory output reached about \$9,500,000; the retail trade amounted to \$5,763,915. The city is an attractive winter resort. It was founded in 1771. Ft. Frederica, built by Gen. Oglethorpe in 1736, and Wesley's Oak, under which John Wesley preached, are landmarks of the vicinity. Brunswick has associations with AARON BURR and SIDNEY LANIER. Pop. 1920, 14,413; 1930, 14,022.

**BRUNSWICK**, a village in Cumberland Co., southwestern Maine, on the Androscoggin River, 28 mi. northeast of Portland. It is served by the Maine Central Railroad. Hydro-electric power is supplied by the river. Brunswick has paper, pulp and cotton mills. The village is the seat of Bowdoin College, with a resident student body of about 500. Bowdoin was the Alma Mater of Henry Wadsworth Longfellow, Nathaniel Hawthorne, Robert E. Peary and other noted men. Pop. 1920, 5,784; 1930, 6,144.

**BRUNSWICK, HOUSE OF**, a German noble family founded in the 12th century by Henry the Lion, a vassal of Frederick Barbarossa. As a result of his rebellious activities Henry lost his extensive possessions in the Saxon duchy and in Bavaria, and by 1181 retained control only of Brunswick and Lüneburg. Henry's grandson, Otto the Child, became the first Duke of Brunswick, 1235. The power of this family was dissipated and weakened through five centuries of strife and domestic conflict. Participation in the Welf-Wittelsbach feud and in the religious quarrels of the Reformation and post-Reformation periods, and private family disputes eventually resulted in the formation of seven distinct branches of the family, the most prominent being the Brunswick-Wolfenbüttel line which died out in 1884, and the Brunswick-Lüneburg line. The latter branch eventually secured control of Hanover, and one of its members married a granddaughter of King James I of England. It thus happened that a Brunswick-Lüneburg-Hanoverian, George Louis, became King George I of England upon the death of his cousin Queen Anne, 1714.

From 1806-14 Brunswick was incorporated in the Kingdom of Westphalia, a Napoleonic creation, but it was restored to the "legitimate" rulers by the CONGRESS OF VIENNA. Upon the death of the last Brunswick-Wolfenbüttel, William, in 1884, the Duke of Cumberland claimed Brunswick, but since he refused to recognize the constitution of the German Empire Bismarck preferred to appoint Prince Albert of Prussia regent, 1885-1906. From 1906-13 the Duke of Mecklenburg acted as regent. Finally, in 1913, the land was given to Ernst August, second son of the

Duke of Cumberland, after his marriage with a daughter of Emperor William II. After the World War, of course, Brunswick, like all the other German states, became republican.

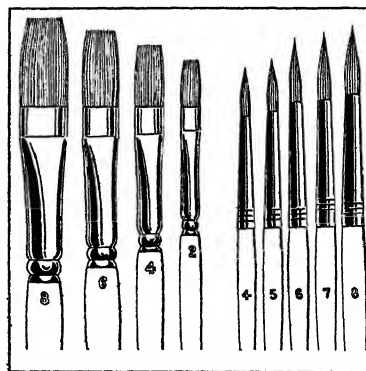
See O. von Heinemann, *Geschichte von Braunschweig und Hannover*, 1884-92.

**BRUSA.** See BURSA.

**BRUSH, CHARLES FRANCIS** (1849-1929), American engineer and inventor, was born in Euclid, O., Mar. 17, 1849, and studied mining engineering at the University of Michigan. In 1870-73 he worked in Cleveland, O., as an analytical chemist, and while engaged as a commission agent for metals in 1873-77, completed the Brush dynamo. In 1878 he invented the electric arc light which is now in general use. Two years later he organized the Brush Electric Co. to control his original patents and those covering later improvements on the above inventions. He received many honors for his contributions to electrical science. Brush died in Cleveland, June 15, 1929.

**BRUSH, GEORGE DE FOREST** (1855- ), American painter, was born at Shelbyville, Tenn., Sept. 28, 1855. He studied at the National Academy of Design, New York City, and at the École des Beaux-Arts, Paris. In 1883 his pictures of Western Indians were first to attract public notice. Brush received awards at the expositions of Chicago, 1893; Paris, 1900; Buffalo, 1901; and St. Louis, 1904. Among his famous paintings are *In the Garden*, Metropolitan Museum, New York City; *Mother and Child*, Boston Museum; *Mother and Children*, Pennsylvania Academy, Philadelphia; *Mother and Child*, Corcoran Art Gallery, Washington; *Portrait of a Young Woman*, Smith College; and *Family Group*, Art Institute, Chicago.

**BRUSH**, a tuft or tufts of hair or bristle, set in a handle, and used to apply color to surfaces. White hog bristles and red sable hair of many kinds are the most frequently employed. "Camel's-hair," in reality



TYPES OF ARTISTS' BRUSHES USED FOR OIL AND WATER COLOR PAINTING

the hair of Russian squirrel, is soft, but has less spring than red sable, which readily resumes its proper shape after each stroke. The hairs are usually from the tails of the animals, and are set with the butt-ends fastened into the handle, where they may be bound by leather

or metal, or set in rubber or cement. Paintbrushes have been used since the Stone Age, and those of the Egyptians of 3000 B.C. about equaled in quality those of modern times.

**BRUSH TURKEY** (*Catheturus lathami*), the Australian name for the largest of the Megapods, a large fowl-like bird of eastern Australia and New Guinea where it frequents dense thickets along streams or near the seashore. It is about the size of a hen-turkey, with blackish-brown and grayish plumage, nearly naked reddish head and neck and a conspicuous yellow wattle. This bird has the remarkable habit of depositing its eggs inside of incubating mounds of earth and decaying vegetable matter which it scrapes together. Sometimes these mounds, usually pyramidal in shape, are of great size, occasionally measuring 6 ft. in height and 14 ft. in diameter. When hatched by the interior heat of the mound the young are fully feathered and ready to shift for themselves.

**BRUSSELS**, the capital of Belgium, described three centuries ago as one of the finest, largest, and best located cities of Europe, is situated about 70 mi. inland from Ostend. The development of Brussels goes back to the 10th century, and in 1200 it had its commercial center and its aristocratic neighborhood, corresponding to the present business section and quarter of the Royal Palace. The 13th century church of St. Gudule is an imposing example of pointed Gothic architecture, and contains excellent stained glass. The most famous buildings of Brussels are those located on its Grande Place, particularly the elaborate Hôtel de Ville, which was built in the 15th century; among the smaller buildings are the Maison du Roi, and several fine old Guild Halls. The Palais de Justice is one of the remarkable public buildings of the 19th century. Brussels is rich in parks and boulevards; since the World War several new streets have been cut and new monuments erected, notably the tomb of the Unknown Soldier and the British memorial to the brotherhood of the two nations. The Germans occupied Brussels from Aug. 1914, to Nov. 1918. It was in a suburb of this city that EDITH CAVELL was executed Oct. 12, 1915. Industrially, Brussels is famous for its lace and carpets. Although it is renowned primarily as the seat of the court and the government, it has varied manufactures, and is an important railroad center. Commerce and industry have been revived with remarkable vigor since the World War and educational advantages have been widely improved. Pop. 1930, 209,828.

**BRUSSELS SPROUTS**, one of the seven distinct vegetables developed from the wild cabbage (*Brassica oleracea* of the mustard family), native to the northwestern shores of Europe. Seedlings and young plants cannot be distinguished from those of CABBAGE, CAULIFLOWER, BROCCOLI, KALE, COLLARDS and KOHL RABI, but as the plants approach maturity the buds, formed at the bases of the leaf stalks develop like miniature, globular cabbage heads. The lowest buds and those highest on the stems seldom grow large, but when conditions are favorable the latter often do

increase after the mid-stem sprouts are removed. Brussels sprouts thrive wherever cabbage succeeds. It does best in rich, moist but well-drained soil and under the same conditions as late cauliflower. Seed is sown in late spring, the seedlings transplanted 30 to 36 in. apart each way before midsummer and kept cleanly cultivated until the sprouts begin to form in the fall. When the sprouts are about an inch in diameter they are cut for use. The plants are hardy and may be left standing in the ground until winter or pulled up and hung tops downward or planted in wet sand in a moist, dark cellar. Many of the small buds will develop during winter. M. G. K.

**BRUTUS, MARCUS JUNIUS** (c. 85-42 B.C.), champion of the Roman republic and assassin of JULIUS CAESAR. He sprang from a family long distinguished by its passionate love of freedom, his remote ancestor Lucius Junius Brutus having taken a leading part in expelling Tarquinius Superbus, the last of Rome's kings, 509 B.C. He aligned himself with GNAEUS POMPEY in the war against Caesar, but after the defeat of Pompey at the BATTLE OF PHARSALUS, 48 B.C., he was pardoned by Caesar and appointed governor of Cisalpine Gaul, 46 B.C. Despite kindly treatment by Caesar and the assurance of an appointment to the governorship of Macedonia, Brutus, hating Caesar's dictatorial government, joined in a conspiracy to murder him, March 15, 44 B.C. Fleeing from the wrath of the Roman populace roused by MARK ANTONY, Brutus took refuge in Macedonia, rallying to his standard a large army. Soon his fellow conspirator GAIUS CASSIUS at the head of the legions of Syria joined him. But their combined forces were defeated by Antony and Octavian, the avengers of Caesar, at the BATTLE OF PHILIPPI, 42 B.C. Rather than surrender to the victors Brutus fell on his sword.

**BRUXELLES.** See BRUSSELS.

**BRYAN, ELMER BURRITT** (1865- ), American educator, was born at Van Wert, O., Apr. 23, 1865. He graduated in 1893 at Indiana University and from 1898-1900 studied at Clark University and at Harvard. Bryan was president of Franklin College from 1905-09 and of Colgate University from 1909 to 1921, when he was appointed to the same office in Ohio University. He is the author of *The Basis of Practical Teaching* and *Fundamental Facts for the Teacher*.

**BRYAN, WILLIAM JENNINGS** (1860-1925), orator and political leader, was born at Salem, Ill., March 19, 1860. The son of a farmer, he was graduated from Illinois College in 1881. Although he studied at the Union College of Law, his legal training was acquired for the most part by reading law in the office of an experienced attorney, a custom common at that time. Admitted to the bar in 1883, he began the practice of law at Jacksonville, Ill. Here he remained for four years when, in 1887, he moved to Lincoln, Neb. In 1890 Bryan was sent to Congress, where he remained for two terms. Defeated for the Senate in 1894, he turned to journalism and became editor of the *Omaha World-Herald*. His abil-

ity as an orator had been recognized in his college days, and when the free silver agitation swept the country, Bryan's unusual talents were brought into play. At the Democratic convention in Chicago, in 1896, his famous "Cross of Gold" speech won for him the presidential nomination. Although he lost to McKinley in the free silver campaign, Bryan established a reputation in the Democratic party as the zealous champion of the cause of the common people against the vested interests. For 30 years he retained the leadership of the more radical factions in his party. In 1900 the youthful standard bearer of 1896 won the presidential nomination by acclaim, only to lose again to McKinley. Four years later the Eastern interests were too strong for the Bryan forces and succeeded in nominating Judge Alton B. Parker, of New York. Parker's defeat, however, only went to show that the Democrats could not win with a conservative candidate; consequently, in 1908, the Democrats once more turned to Bryan, and for a third time the silver-tongued orator went down to defeat. Despite his defeats he retained sufficient influence in the party to secure the nomination of Woodrow Wilson in 1912. As his political reward, Bryan was appointed Secretary of State. He strongly supported the President in his legislative program, but his most notable achievement in the State Department was his work for peace. He negotiated some 30 arbitration treaties, whereby the signatories were bound to wait at least a year before commencing hostilities after having submitted the dispute to a commission composed of representatives of both parties. Finding himself opposed to the belligerent tone of President Wilson's second Lusitania message, Bryan felt compelled to resign as head of the State Department. His resignation became effective June 9, 1915, the day the message was despatched to Germany.

Bryan never outgrew his early religious training, and towards the close of his life he became intolerant to modern scientific ideas. Perfectly honest and sincere himself, he could not understand why others should question what to him seemed so obviously true. His official political organ was *The Commoner*, a paper he started in Lincoln, Neb., in 1901. Prohibition and Fundamentalism are both closely associated with his name. It was but five days after his last battle, his efforts to secure the conviction of Scopes, a Dayton, Tenn., instructor, for violation of the state anti-evolution law, that Bryan passed away in his sleep, while still at Dayton, Aug. 26, 1925.

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**BRYAN, WILLIAM LOWE** (1860- ), American educator, was born near Bloomington, Ind., Nov. 11, 1860. He graduated at Indiana University, where he became instructor in Greek in 1884 and the next year professor of philosophy. In 1900-01 he studied at Berlin, Paris and Wurzburg and returned to Indiana University in 1902 as president. In 1910 he be-

came a trustee of the Carnegie Foundation for the Advancement of Teaching. He is the author of *Plato the Teacher* and *The Spirit of Indiana*.

**BRYAN**, a city and county seat in Brazos Co., in eastern central Texas, situated 100 mi. northwest of Houston. Bus lines and two railroads serve the city. Bryan is a shipping center for cotton, the chief product of the district. It is the seat of Allen Academy for Boys; the Agricultural and Mechanical College of Texas is situated nearby, at College Station. The city was incorporated in 1886 and has had the commission-manager form of government since 1917. Pop. 1920, 6,307; 1930, 7,814.

**BRYANT, WILLIAM CULLEN** (1794-1878), American poet, was born at Cummington, Mass., Nov. 3, 1794. At 10 he made translations from Latin poets, and when 16 entered the sophomore class of Williams College. Lack of funds, however, forced him to leave after two sessions. *Thanatopsis*, the first great poem produced in America, was written when he was a youth of 18. His *Inscription for an Entrance to a Wood* followed the next year, and *To a Waterfowl* was written when the poet was 21. *Thanatopsis* was published by the *North American Review* in 1817, and Bryant was immediately recognized as a notable poet, the first to appear in America. After practising law for 9 years in Great Barrington, Mass., Bryant came to New York City, and in 1826 he was invited to join the staff of the *Evening Post*. Three years later he became its editor and part owner, and for nearly 50 years devoted much of his time to the paper. The connection probably limited his poetical productiveness, but it rescued him from poverty. It also enabled him to play a constructive part in the public events of his day. The *Evening Post*, under his leadership, became known for its sound moral principles and high literary quality.

Bryant produced only about 160 poems, most of which express his love of nature. His work reflects the austerity, the emotional restraint and the lofty moral tone of his environment. Thus, while it lacks ardor and the far flight of imagination, the New England of his day finds high expression in his poems. Bryant died at New York City, June 12, 1878. See also AMERICAN LITERATURE.

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**BRYCE, JAMES, VISCOUNT** (1838-1922), British statesman and author, was born at Belfast, Ireland, on May 10, 1838. He studied at the University of Glasgow and at Oxford, making an exceptionally fine record at the latter. In 1862 he was made a fellow of Oriel College. In 1864 he published *Holy Roman Empire*, a brilliant work upon which students of history invariably depend and which gained the Arnold Historical Essay Prize for Bryce in 1863. In 1867 he was admitted to the bar, and in 1870 was made Regius professor of civil law at Oxford. In the same year he visited America, beginning the accumulation of knowledge of American civil systems and American manners



which he put into *The American Commonwealth*, published in 1888. His interest in the Armenians began in 1876, when he toured in the Near East. In 1880 he married Elizabeth Marion Hyde. During 1886 he was under secretary of foreign affairs under Gladstone, and in 1892-95 headed several committees dealing with national problems. As an outgrowth of his travels in 1895 the *Impressions of South Africa* appeared in 1897. In the Boer War he sympathized with the Boers. In 1907-13 Bryce was ambassador at Washington, dealing principally in relations between Canada and the United States and leaving the diplomatic relations between the two countries highly satisfactory. He was made a viscount in 1913. During the World War he headed a committee concerned with the outrages committed by German soldiers in France and Belgium. He spoke last in the House of Lords in 1921 on the treaty with Ireland and in public at Mansion House in London in an appeal for Armenian relief. He died at Sidmouth on Jan. 22, 1922.

**BRYCE CANYON NATIONAL PARK**, located in southwestern Utah in the same desert region which produced the **GRAND CANYON**, was established Sept. 15, 1928. It had previously been a national monument. Bryce Canyon is an immense bowl or amphitheater, 3 mi. long and 2 mi. wide, cut into the Paunsaugunt Plateau to a depth of 1,000 ft. The walls are a series of red, pink and cream colored sandstone pinnacles, shot with a wealth of exotic hues which vary from hour to hour and are so fantastically eroded as to defy description.

The park is reached by rail over the Union Pacific system from Salt Lake City to Cedar City, Utah, and thence by motor bus to the park. Motorists turn east from U.S. Interstate Highway No. 89 about 4 mi. south of the town of Panguitch.

**BRYN MAWR COLLEGE**, a non-sectarian institution for women, at Bryn Mawr, Pa., founded in 1880 by Joseph W. Taylor, a member of the Society of Orthodox Friends. The courses given lead to the A.B., M.A. and Ph.D. degrees. The enrollment of undergraduates is limited to about 400, and of graduate students to 100. The productive funds of the college in 1931 were \$5,939,235, and \$60,000 are given each year for fellowships and scholarships. The library contains 135,000 volumes. In 1931-32 there were 491 students and a faculty of 83, headed by MARION EDWARDS PARK.

**BRYONY** (*Bryonia dioica*), a climbing perennial of the gourd family native to the Old World, sometimes grown as cover vine. It bears deeply lobed leaves, yellow flowers, and orange-red berries. The acrid roots possess medicinal properties. The black bryony (*Tamus communis*), an elegant climbing vine of the yam family, native also to the Old World, has black roots, shining heart-shaped leaves, small yellowish-green flowers and scarlet berries.

**BRYOPHYTES**, a group name for the Mosses and LIVERWORTS, which are terrestrial green plants, but have no true roots. Some, as in most liverworts, are mere thallus plants, but the true mosses have stems

and minute but functionally active leaves. All of them require water to complete their life cycle, alternation of generations and a free swimming sperm cell, being characteristic of the group.

**BRYOZOA** or **POLYZOA**, the names for a phylum of invertebrate animals, which usually form colonies of plant-like appearance. Indeed the name Bryozoa means moss animals. Most of them are found in the ocean, and occur both in shallow water and the deep sea, but a few forms live in fresh water. Individual members (*zoecia*) of a colony are seldom over 1/25 in. long. They generally are enveloped in a hard case which protects their soft bodies. Projecting above the case is a round, oval or horseshoe shaped ridge, the lophophore, bearing tentacles, which, in some forms, can be withdrawn into the case.

The colonies of shallow water forms frequently encrust stones, shells or seaweeds. Among deep water species they are more often erect and branching. Some colonies, too, have the form of flat mats, while others are solid masses. Commonly they are not more than an inch across; some, however, may be a foot in diameter.

In one order, *Cheilostromata*, there is usually division of labor among the members of the colony, some zooids (*avicularia* and *vibracula*) being modified for seizing and holding food, and others for defense.

Individuals of both sexes are generally found in any one colony, and among many species the *zoecia* are hermaphrodites. The egg gives rise to a ciliated larva, which soon settles down and attaches itself to some object on the bottom. It develops into a *zoecium*, which gives rise to other *zoecia* by budding. These, in turn, bud off more *zoecia*, and this process is continued until an entire colony is thus built up by vegetative growth. A. I. W.

**BUBO**, enlargement of a lymph gland in the groin as a result of inflammation. The most common cause for the inflammation is venereal infection. In most instances, pus forms within the gland and the condition is then relieved by incision and drainage of the pus.

There is a special type known as climatic bubo, occurring especially in Asia and Africa. The causal agent is unknown. Males only are affected. There is irregular fever, with marked inflammation of the lymph glands in the groin and severe pain. The treatment consists of rest and local applications for the relief of pain. Operation is advisable if pus formation occurs.

**BUBONIC PLAGUE.** See **PLAGUE**.

**BUCARAMANGA**, a city of Colombia, and capital of the state of Santander Sur, situated in a mountainous district, at an elevation of 2,850 ft., about 185 mi. northeast of Bogotá, the capital of Colombia. The surrounding mountains are rich in deposits of gold and silver, and the valleys produce cotton, tobacco and a fine quality of coffee. Pop. 1928, 44,083.

**BUCHANAN, JAMES** (1791-1868), 15th President of the United States, was born near Mercersburg,

Pa., Apr. 23, 1791, the second of 11 children. His father, James Buchanan, a successful merchant, had immigrated to America in 1783, and his mother, Elizabeth Speer Buchanan, was a frontier woman with a surprising bent for good reading; both parents were of Scotch-Irish Presbyterian descent. James was given a good secondary education at a Mercersburg school and in 1807 entered Dickinson College at Carlisle, Pa., where he was graduated two years later. He determined upon a career in law and studied for the bar at Lancaster, Pa. In 1812 Buchanan was admitted to the bar, and began practicing.

His oratorical ability soon drew him into politics, but he did not forsake legal practice. The extent of his ability as a pleader is evidenced by his annual income after only three years at the bar, of \$11,000. In 1814 he was elected to the Pennsylvania House of Representatives on the Federalist ticket, and opposed the declaration of war with England, although upon its outbreak he volunteered for militia service. He was reelected to the state legislature in 1815, and in 1821 took his seat in the national House of Representatives, where he remained for 10 years. When the Federalist party was dissolved, Buchanan entered the Democratic fold. His chief labors related to his chairmanship of the Judiciary Committee, where his sound legal judgment became a congressional by-word. In 1831 Buchanan determined to retire from public life but the party, loath to lose his participation in political affairs, persuaded him to accept the ministry to Russia. At St. Petersburg he obtained the Czar's signature to a revised commercial treaty with the United States. He returned in 1833. The following year Buchanan, already mentioned for the Vice-Presidency, was elected to the Senate, in which he remained until 1845, loyally supporting Jackson and Van Buren. During the Polk administration he was Secretary of State, an office made difficult by the Texas annexation, the Mexican War, and the discussions with England relative to the Oregon boundaries. In 1849 he retired, and bought Wheatland, an estate near Lancaster, although a movement was already underway to nominate him for President at the Democratic Convention of 1852. Although Buchanan was the logical candidate, the convention on the 49th ballot nominated the "dark horse," Franklin Pierce. In 1853 the latter appointed Buchanan minister to Great Britain. The envoy was one of the three signatories to the Ostend Manifesto 1854, urging upon the Washington government the purchase or seizing of Cuba from Spain. Studying the slavery issue from the perspective of residence abroad, Buchanan changed his first convictions, and on his return to the United States in 1856 held that slavery was intrinsically wrong; he escaped the denunciation of the South by a parenthetical assertion that the Federal Government had no right to interfere with slavery in the slave states. Buchanan was therefore an outstanding candidate for the Democratic nomination for President, which he obtained. He received 174 electoral votes and was inaugurated in Mar. 1857.

The chief aim of the President was to end the unprofitable slavery controversy, a task utterly beyond his powers. His acceptance of the DRED SCOTT Decision and his attempts to bring Kansas into the Union split the Democrats, and his vigorous foreign policy, notably his intention to obtain Cuba, lost him the support of many northern Democrats. Under the impetus of JOHN BROWN'S RAID in 1859, division of the nation over the slavery issue proceeded rapidly. The President stated that the southern states had no right to secede but that the nation could not use force to prevent them. In Mar. 1861, he gave over his duties to Lincoln with evident relief.

Buchanan retired to Wheatland. He supported Lincoln throughout the war. His last years were spent writing a defense of his much criticized Presidency, *Mr. Buchanan's Administration on the Eve of the Rebellion*. He died at Wheatland on June 1, 1868, following an attack of rheumatic gout, and was buried in Woodward Hill Cemetery, Lancaster, Pa.

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**BUCHAREST**, capital of the kingdom of Rumania, situated on both banks of the Dimbovitza River, a tributary of the Danube. The city is attractively built, being crossed by wide boulevards, of which the principal one, lined by imposing government and private buildings, is the Calea Victoriei. Other important thoroughfares are the boulevards Protopesco, Elisabetei, Independentei and Universitatei. Among the noteworthy buildings are the Royal Palace, the National Theater, the Palace of Justice and the Cathedral of the metropolitan of Rumania. There are more than a hundred smaller Greek Orthodox churches, nearly all in Byzantine style; the best known of these are the Doamna Belasa, dating from 1751 and Spiridon the New, finished in 1768. There are also Protestant churches, synagogues and a Roman Catholic cathedral.

Bucharest is the seat of Rumania's largest educational institutions. Besides the university, founded in 1864, which in 1928 had a faculty of 500 and a student body of 8,000, there are many theological, commercial, scientific and art schools. Private and state owned libraries, a national theater, and ethnographic and natural history museums add to the educational facilities. Like most European capitals, Bucharest, besides being the political, cultural and educational center of the country, is the financial, commercial and industrial center as well. It is connected by railways with the entire kingdom. The principal industries are the manufacture of textiles, soap, bricks, and iron articles such as nails, wire and machinery, candy, paper, leather goods, furniture, buttons, ropes and army supplies also are made. Other important industries are refineries and distilling plants.

Bucharest, which was probably founded on the site of a Roman fortress, was destroyed by the Turks in 1595. A century later it became the capital of the principality of Wallachia. During the 18th and 19th centuries it frequently changed hands between Turks,

Russians and Austrians. In 1861, upon the creation of the Rumanian kingdom by the union of Wallachia and Moldavia, Bucharest was chosen as the capital. See RUMANIA. In 1916 the German and Bulgarian armies invaded the city and the government of Rumania transferred its seat to Jassy, in Moldavia. Upon the capitulation of the Central Powers in 1918 Bucharest again became the capital, this time of a much enlarged Rumania. Since then the city has shown a phenomenal growth. The population in 1918 was barely 350,000. Pop. 1930, 631,288.

**BUCHAREST, TREATY OF.** The Treaty of Bucharest, Aug. 10, 1913, followed the Second Balkan War and the defeat of Bulgaria by her former allies, Serbia, Montenegro and Greece joined by Rumania and Turkey. (See BALKAN WARS.) It marked an important change in the balance of power in the Balkans in favor of Serbia and the Slavs. Serbia obtained central and part of southern Macedonia and one half of the Sanjak of Novibazar, the other half going to Montenegro. Greece got Crete, most of southern Macedonia, including Salonika. Rumania obtained a strip of the southern Dobradja ceded to her by Bulgaria which also had to restore eastern Thrace with Adrianople to Turkey, retaining only western Thrace and a strip of Macedonia. Albania was separated from Turkey and later organized under William of Wied as an independent principality.

The disturbance of the balance of power in the Balkans was greatly in favor of Russia and against Austria-Hungary, while the dismemberment of Turkey, leaving her only the little triangle east of the Inos-Media line, was very unwelcome in Germany which had replaced England at Constantinople as the friend of Turkey. Nor were the Balkan states satisfied, despite the large accessions of territory. In Serbia feeling was bitter against Austria-Hungary and Italy because they had forced her to relinquish Durazzo, a coveted outlet on the Adriatic. Bulgaria was even more dissatisfied. After having borne the brunt of the fighting against the Turks in 1912, the war of 1913 with her former allies cost her the loss of central Macedonia and of eastern Thrace and the extension of her coast line on the Aegean. Thus the treaty of Bucharest, although it marks another step forward in the disintegration of Turkey and the expulsion of the Turks from Europe, increased rather than decreased difficulties in the Balkans. Not only were the causes of jealousy and friction between the Balkan states themselves greater, but the antagonism of Serbia to Austria-Hungary was greatly intensified. Encouraged by their success in the acquisition of territory Serbian nationalists envisaged the prospects of still larger gains at the expense of the Dual Monarchy.

**BUCHARIN, NIKOLAI** (1888- ), Russian Bolshevik leader, born in Moscow in 1888 where he was educated and where he later became a professor at the University. In 1917 he came to New York to found a radical newspaper, but returned to Russia after the overthrow of the Tsar and threw

himself with enthusiasm into the propaganda for a world revolution under the Third International. A staunch supporter first of Lenin, and later of Stalin, he replaced Zinoviev as head of the Political Bureau of the Communist Party, after the quarrel between Stalin and Trotsky in 1926.

**BUCHU**, the name given to the bitter, leathery leaves produced by several species of *Barosma*, especially *B. betulina*, small, heavy-scented, evergreen shrubs of the rue family, native to the Cape of Good Hope. Buchu leaves were formerly extensively used in medicine for their diuretic, stimulant and stomachic properties.

**BUCKBEAN** (*Menyanthes trifoliata*), a perennial herb of the gentian family, found in boggy places in northern and arctic regions throughout the world. It is a smooth plant, about a foot high, with basal leaves of three leaflets and naked flower-stalks rising from a thick creeping rootstock. The small, five-parted, usually white flowers, borne in clusters, are covered on the upper surface with a copious white beard.

**BUCKET EXCAVATORS**, machines used in large excavating projects when expensive machinery is justified. They are self-propelled on rails or crawlers, and comprise a cabin structure from which extends a movable arm equipped with a continuous chain, provided with buckets. The arm can be lowered to a considerable depth below the rails or crawler, or can work at a higher level. The moving buckets scrape the earth and carry it to hoppers in the cabin, whence it is delivered to dump cars or trucks. These machines have been extensively used in Germany for strip-mining, canal excavation, and other purposes. They have capacities up to 20,000 cubic yards per hour.

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**BUCKEYE**, a name given in the United States to the native species of *Aesculus*, a genus of medium-sized trees of the HORSE CHESTNUT family. There are about 16 species native to the north temperate zone, 6 of which occur in North America, mostly in the southeastern United States. They are handsome trees with stout, round branchlets; ill-scented, bitter bark; opposite leaves composed of 5 to 9 digitate leaflets; showy white, red or yellow flowers in conspicuous clusters, and a large, leathery, sometimes prickly fruiting capsule containing smooth, brown, inedible seeds.

Representative species are the Ohio buckeye (*A. glabra*), with prickly fruit and yellow flowers; the sweet buckeye (*A. octandra*), with smooth fruit and red to pink and yellow flowers; the red buckeye (*A. pauciflora*), with smooth fruit and dark red flowers; the white buckeye (*A. parviflora*), a handsome shrub of the southern states with white flowers, and the California buckeye (*A. californica*), with rose colored flowers. Most of the native buckeyes are more or less grown as ornamentals.

**BUCKEYE BUTTERFLY**, a species of butterfly (*Junonia cœnia*) of the family *Nymphalidae*, in the group known as the angle-wings. Larvæ feed on gerardia, plantain and snapdragon. They are dark

gray in color, marked with yellow, and have purple spines. Adult butterflies are olive. On each fore wing is a large eye-spot set in a white band. One large and one smaller eye-spot are present in each hind wing.

**BUCKHANNON**, a city in central West Virginia, the county seat of Upshur Co., situated on the Buckhannon River, 28 mi. south of Clarksburg. It is served by bus lines, by the Baltimore and Ohio Railroad and the airport known as Lewis Field. Coal, oil and gas are found in the vicinity; grain and potatoes are the chief crops of the region. The principal local manufacture is clothing. Buckhannon is the seat of the West Virginia Wesleyan College, founded in 1890. The Pringle Tree, in which during the American Revolution two deserters from the British Army lived for two years, is of historical interest. Buckhannon was founded in 1764 and incorporated in 1851. Pop. 1920, 3,785; 1930, 4,374.

**BUCKINGHAM MEMORIAL FOUNTAIN**, a monument in Grant Park, Chicago, Ill., said to be the most beautiful in America. Looming 90 ft. high, the fountain stands in the Park at the foot of Congress Street. Especially attractive at night, when the play of colored lights transforms the water to iridescent foam, the fountain changes color in a nebulous mist every few minutes. A series of smaller fountains at the round base, together with four green sea horses, spurt parabolas of water toward the central column. The largest fountain of its type in the world, costing \$700,000 to build, it was patterned after the famous Latona Fountain of Versailles, but is twice as large. Miss Kate Buckingham donated the fountain to the city as a memorial to her brother, Clarence Buckingham, art collector and a trustee of the Chicago Art Institute, who died in 1913.

**BUCKINGHAM PALACE**, the town residence of the British sovereign, at the west end of St. James's Park, London. Originally erected by Lord Goring in the reign of James I (1566-1625), it was rebuilt after a fire by the Earl of Arlington in 1674, and was again rebuilt in 1703 by John Sheffield, Duke of Buckingham. George III, purchased Buckingham House in 1761 and bestowed it as the "Queen's House" upon Queen Charlotte. Between 1825 and 1836 the palace was reconstructed on its old foundations by John Nash. In 1837 Queen Victoria chose Buckingham as the royal residence, which it has since continued to be.

The palace is quadrangular in shape, an Italian Renaissance design executed in Portland stone. The three pavilions in front are crowned by pediments, each pediment supported by two Corinthian columns and flanking pilasters, with the tympanum of the central pediment sculptured with the royal arms. The emphasized cornice, supported by dentils, is surmounted by a balustrade which extends round the entire building. A balustraded balcony projects from the first floor. The east wing, designed by Edward Blore, was added in 1846. Blore's 360 ft. façade was replaced in 1913 by the present façade designed by Sir Aston Webb.

The principal state apartments are the Sculpture Gallery, Library, Green Drawing Room, Throne Room, Grand Saloon, Picture Gallery and the Ballroom, 111 ft. by 60 ft. The palace gardens of 40 acres contain a small lake and a frescoed pavilion. South of the palace are the Royal Mews.

**BUCKLE, HENRY THOMAS** (1821-62), English historian, was born at Lee, Kent, Nov. 24, 1821. Left a fortune in 1840 on the death of his father, a rich ship owner, he spent his time in study and travel. In 1857 the first volume of his remarkable work, *The History of Civilization in England*, was published and brought him world-wide and lasting fame. Shortly after publication of the second volume, 1861, he was stricken by fever and died in Damascus, Syria, May 29, 1862.

**BUCKNELL UNIVERSITY**, at Lewisburg, Pa., a privately controlled, coeducational institution affiliated with the Baptist Church. The institution, founded as "the University at Lewisburg" in 1846, adopted its present name in 1886 in honor of William Bucknell of Philadelphia. Bucknell has separate grounds and buildings for the women students. In 1931 the productive funds were \$1,335,560. The library contains 52,000 volumes. In 1931-32 there was a student enrollment of 1,109 and a faculty of 69 headed by Pres. HOMER P. RAINEY.

**BUCK STOVE AND RANGE CASE**, an industrial dispute, notable in the history of organized labor in the United States involving the use of the boycott, the blacklist, and the blanket injunction. The American Federation of Labor in 1906 supported the local union of metal polishers striking against the Buck Stove and Range Company, St. Louis, for a nine-hour day; an effective boycott of the firm's products was instituted by the official periodical, *The American Federationist*. An injunction granted the firm by the Supreme Court of the District of Columbia enjoined the officers and members of the Federation from referring to the dispute in print or orally. After denouncing the injunction Samuel Gompers, president, and two other officers of the federation were sentenced for contempt of court, though they escaped prison terms on a technicality. The case was prolonged until dismissed by the U. S. Supreme Court in 1914.

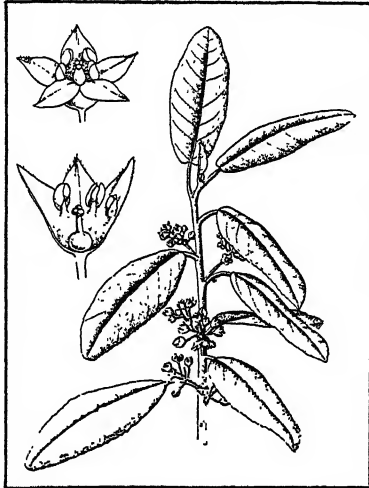
**BUCKTAILS**, originally a nickname for members of TAMMANY HALL; from 1817-26, the faction, including Tammany members, of the Republican party in New York State opposed to DeWitt Clinton. See CLINTONIANS.

**BUCKTHORN**, a large genus (*Rhamnus*) of handsome, often thorny, shrubs and small trees, including many ornamental, medicinal and dye plants. Of nearly 100 species, found chiefly in north temperate regions, about 12 are native to North America. They are usually widely branching shrubs, 1 to 10 ft. high, with smooth leaves, greenish flowers and a berry-like fruit.

The purging buckthorn (*R. cathartica*), and the alder buckthorn (*R. Frangula*), both Old World

shrubs planted for ornament, are sparingly naturalized in eastern North America. These and various other Old World species yield cathartic drugs and coloring materials.

The lance-leaved buckthorn (*R. lanceolata*) and the swamp buckthorn (*R. alnifolia*), both small shrubs,



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

CALIFORNIA BUCKTHORN OR COFFEE  
BERRY

Flower, section of flower and branchlet

occur in the eastern United States. In the South is found the Indian cherry (*R. caroliniana*), a small tree, 15 to 40 ft. high. On the Pacific slope the best known species are the cascara sagrada (*R. Purshiana*), yielding the well known drug; the coffee berry (*R. californica*), and the red berry (*R. crocea*), an elegant evergreen shrub with bright red berries. See also RHAMNUS.

**BUCKWHEAT**, an annual food plant (*Fagopyrum esculentum*) of the buckwheat family, native to Siberia and Manchuria. The name is apparently a corruption of the German *Buchweizen* or beech-wheat, in allusion to the seed which in form resembles beech nuts but has the food characteristics of wheat. Strictly speaking it is not a cereal though classed as such in market reports. From prehistoric times buckwheat has been extensively cultivated in China. In Japan and Russia it is a leading crop and from the latter it spread westward through Europe.

The plant is an erect, branching herb with heart-shaped leaves and usually white flowers that secrete abundant nectar and make a highly esteemed dark honey. Buckwheat is widely grown as a green manure because of its ability to produce abundant foliage, smother weeds and decay quickly when plowed under. Its chief value, however, is its grain, which is used for stock feed and by the poorer classes of the Old World for bread. In America it has reached its apotheosis as griddle cakes.

Though buckwheat thrives best in moist cool climates its seed will germinate well in dry soil. Hence its popular northern sowing up to midsummer. As

### BUCKWHEAT PRODUCTION, U.S.

7-Year Average, 1924-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES . . . . .	733,000	12,768,000	100.0
LEADING STATES:			
New York . . . . .	208,000	3,875,000	30.3
Pennsylvania . . . . .	200,000	3,824,000	29.9
Minnesota . . . . .	75,000	978,000	7.7
Michigan . . . . .	46,000	590,000	4.6
Ohio . . . . .	30,000	542,000	4.2

it is tender to cold it must be sown late enough to avoid frost. Eight to ten weeks from seeding will bring it to maturity. It thrives on a wide range of soils which are prepared as for cereals. M.G.K.

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**BUCOLIC VERSE**, a form much the same as PASTORAL poetry. The word is derived from the Greek word meaning herdsmen. Bucolic poetry, however, has become more agricultural in subject matter than mere pastoral. Bucolic was the term often applied to Virgil's *Eclogues*. Other classic bucolics are the collection of THEOCRITUS. The only famous modern collection so called are those entitled *Les Bucoliques* by RONSARD.

**BUCYRUS**, a city in northern Ohio, the county seat of Crawford Co., situated on the Sandusky River, 18 mi. north of Marion. It is served by trolleys, bus lines and four railroads. There is an airport. The region is splendid farming country, producing grain, hay and live stock. Chicken hatching is a leading interest. The chief local manufactures are locomotive cranes, steam shovels, grave vaults, copper kettles, road machinery and brick and tile machines. The city has also railroad shops. In 1929 the factory output reached an approximate total of \$5,000,000; the retail business in 1929 amounted to \$6,186,743. Bucyrus was founded in 1821; incorporated as a city in 1886. A few miles east is Mohican State Park. Pop. 1920, 10,425; 1930, 10,027.

**BUDAPEST**, the capital and largest town of the kingdom of Hungary, consists of two cities united in 1872: Buda, on the hills of the western bank of the Danube, and Pest on the east bank, on the Hungarian plain. Together with the adjacent, though administratively not incorporated towns and villages, it accounts for almost 15% of the population of the entire realm.

The origin of the town reaches back 1,500 years to the time when Celtic settlers and Roman legions peopled the site of the present Buda on the right bank of the river. Pest, on the left bank, has no such past to reflect upon; though a city with an ancient history, it developed into a metropolis in 100 years. The original Buda of to-day developed out of the old Roman military camp of Aquincum where Valentinian II was proclaimed Emperor of Rome in 375 B.C. On the remnants of Aquincum, the first king of Hungary, St. Stephen, erected the fortified town of Buda, which later developed and extended towards



its actual site. During the reign of Matthias, 1448-90, the city expanded and changed into a royal residence of great splendor and of European reputation. The Turkish occupation, which lasted for 145 years, destroyed all the accumulated treasures of art, all scientific acquisitions within the city and upon its reconquest on Sept. 2, 1686, nothing but ruins were found on the sites of both cities, Buda and Pest. The restoration was the work of centuries, and the rapid development of Budapest began in the second half of the 19th century.

Pest, on the left bank of the Danube, is the modern part of the town. Running through it in the form of a semi-circle are two broad boulevards, which start from an end on the bank of the river. A number of fine bridges span the Danube between Buda and Pest. The oldest of these is the Suspension Bridge which was built in 1847 and was regarded as a technical marvel of its day. Margaret Bridge, the work of the famous French engineer, Eiffel, has three arms and connects the city with the beautiful St. Margaret Island. This island at the present time is an excellent health resort, with an exclusive park of 150 acres and widely known thermal springs. Besides a renowned sanatorium and modern hotel there is a series of bathing and sporting establishments.

On both sides of the Danube the embankments are lined with rows of palatial edifices; the most striking of these are the Houses of Parliament, a large late-Gothic building on the left bank of the Danube. Opposite Pest the old town of Buda rises toward the undulating heights, with the fortress, Saint Gerard's Hill and the Hill of Roses rising from its midst. The most prominent building on the right side of the Danube is the Royal Castle, a large and imposing building founded about the middle of the 18th century by the Empress and Queen Maria Theresa, modernized and enlarged at the opening of the 20th century as a residence of Emperor and King Francis Joseph I. Besides the Royal Palace there are quite a number of impressive buildings, amongst them is the picturesque Fisher Bastion on the Castle Hill, above it the equestrian statue of Saint Stephen, first king of Hungary and the Coronation Church of St. Matthias, a Gothic edifice of great beauty.

Besides being the cultural center of Hungary with a university and many other institutions of learning, museums and charitable foundations, Budapest is the country's most important railroad center and manufacturing city, with mills, distilleries, machine factories and foundries. Pop. 1930, 1,004,681.

**BUDDHISM**, the religion of Buddhists, or followers of The Buddha. See GAUTAMA. It was at first a sect of HINDUISM but soon took form, by the force of many circumstances, as a distinct order and body of teachings. It maintained itself in India for 1,000 years, with much success for several centuries, especially in the days of King Asoka, 272-231 B.C. From the dawn of the Christian era it spread through Asia. Buddhists in the world to-day number about 140,-

000,000, more than one-third of whom are Japanese. An indefinite number, possibly 65 millions, are Chinese. There are 11 millions in Burma, and 2¾ millions in Ceylon. Tibet is wholly Buddhist of the Lamaistic sort. In various parts of India proper there are only 3,000,000 adherents. Whatever the total number of Buddhists, the faith exerts an influence beyond any numerical calculation.

Broadly speaking, Buddhism as religion has existed in two forms, known as Hinayana, or "Little Vehicle," and Mahayana, or "Great Vehicle," behind both of which lies the original body of teachings formulated by The Buddha himself. The Hinayana, sometimes called "southern" Buddhism, is closer, geographically and doctrinally, to the founder, and prevails in Ceylon and Burma. Mahayana, or "northern" Buddhism, represents the transformations due to the spread of the faith to distant lands, and the consequent contacts with assorted elements; it prevails to-day in China and Japan. If any strict interpretation be given, however, to the terms *hina* and *maha*, it might be justifiable to say that Hinayana was the way of the *few*, and Mahayana, a *universal* way.

The main points in Buddha's own view were: (1) The "world" is transitory, nothing abides, "all is impermanent" (*sabba anatta*). Combinations and wholes of any sort are mere names; whatever reality there is, exists in the elements alone which make up the whole; these elements (*dhammas*) are in continual process, forming, dissolving, and reforming by a law or "wheel" of causation (dependent-simultaneous arising); and the root and motive of the process is ignorance of the way to dissipate or overcome it. (2) With reference to man himself, there is no ego, or "soul" (*atta*, or *atman*). Instead, there is in the "body" what we might call "consciousness," composed of feelings, ideas, volitions, and pure sensation. The desired end of man is "cessation," and he himself is the agent. (3) The world is evil and life is suffering (*sabba dukkha*). Birth is the greatest misfortune for man; he must devote himself to disentanglement, to freedom from the operation of *karma*, and escape from rebirth (*punarjamma*). "That he may not come again to birth," is the goal of man's will. (4) There is a "way which giveth vision, which giveth knowledge, which causeth calm, insight, enlightenment, and nibbana (nirvana)"; it lies between the "two extremes" of devotion to the pleasures of sense and devotion to self-mortification; it is the Middle Way, or eight-fold, progressive discipline of right attitude, right resolve, right speech, right action, right living, right effort, right mindfulness and right contemplation. This is the way of the monk (*arhart*) to kill desire (*tanha*, "thirst") which causes suffering (*Dukkha*).

Hinayana is substantially Buddha's own position, except that certain developments had taken place establishing the Order (*sangha*) of monks, and the Law (*dharma*), or discipline and teachings, and exalting Buddha himself to a peculiar position of reverence. Also, questions had begun to arise with respect to

doctrine, certain disciples were in prominent places of leadership, and converts from Hinduism had brought in with them something of their own traditional character. Hinayana was a way for the chosen few who could "take refuge" in the Buddha, the Law, and the Order for the sake of their own salvation.

Mahayana in its full development is of many sects with most intricate systems of doctrine and ritual practice. Ignoring differences of sectarian emphasis upon meditation, sacred scriptures, and the character and efficacy of the ideal Buddha, we may observe that Mahayana recognizes the historical Buddha, believes in *karma* and transmigration, teaches the "Four Noble Truths" and the "Middle Way," emphasizes the value of dependence (man's faith, or God's grace) upon divine powers (the Eternal Buddha, perhaps), holds out hope for all men, and promises heaven and immortality to the unselfishly devout (bodhisats, etc.) and hell to careless and wicked men. In other words, while the historic Gautama assumed there was no Supreme God, nor any power beyond his own will upon which man should depend in prayer or service, Mahayana Buddhism is a virtual polytheism, with all its adjuncts in theology and ritual. It has, also, its own scriptures in addition to the original Canon, for example, The Lotus of the Good Law (Saddharam Pundarika).

J. C. A.

See H. Hackmann, *Buddhism as a Religion*, 1910; K. J. Saunders, *The Story of Buddhism*, 1916; S. Tachibana, *The Ethics of Buddhism*, 1926; J. B. Pratt, *The Pilgrimage of Buddhism*, 1928.

**BUDDHISTS** in the United States. Of the many representatives of foreign religions including Moslems, Hindus, etc., in the continental portion of the United States, the Buddhists constitute the largest community. This follows from the presence here of over 100,000 Japanese, most of whom are at least nominally Buddhist, and many of whom are devoted ardently to the faith in one or another of its sectarian forms. In addition, there are some Buddhists among the more than 50,000 Chinese here. There are many students, tradesmen, and professional men who are of the Buddhist faith. No exact figures are available with reference to the total number and distribution of Buddhists here, and the location of all of their places of worship. In 1926 there were at least 12 temples and 5,639 "communicants." The largest temple outside of Japan was dedicated in 1926 in Los Angeles by Count Atoni, brother-in-law of the Japanese Emperor. Most American Buddhists dwell in California. There are about 5,000 Japanese in Idaho, Wyoming, Nevada, and Utah. The Buddhists among them are served by a fine temple in Salt Lake City. There are Buddhist centers in the East, also. From the New York City center an important magazine, The Maha-Bodhi, is distributed in the interest of the spread of the faith. Among American Buddhist activities are Sunday Schools and Young Men's and Young Women's Associations.

Buddhism was first introduced into America before the Civil War. Many Americans have allied them-

selves with the cause, or have professed conversion to the faith. The chief support, however, has come from Japan. In 1929 some added interest and momentum came from the visit of the Chinese Buddhist abbot Tai Hsu of the tolerant, conciliatory Ti'en Tai sect. Most of the Japanese Buddhists in America belong to the "Pure Land" sects which preach salvation by faith in Amitabha (Buddha of Boundless Light who dwells in the Western Paradise, to which all will go at last who pray in his "Name" and put their trust in him). These sects, Jodo and Jodo Shinshu, represent most nearly Mahayana, or universal Buddhism. The headquarters are in Kyoto, in America, San Francisco.

J. C. A.

**BUDDING**, a horticultural process whereby a bud of one plant variety is inserted beneath the bark of another kind, usually a seedling, and made to grow upon it. When the operation is successful a union is made by means of the cambium tissues of both, the bud develops into a stem or branch and bears foliage, flowers and fruit characteristic of the bud, not of the plant on which it was budded. See GRAFTING.

**BUDĚJOVICE ČESKÉ** (German *Budweis*), a Czechoslovak city in south Bohemia on the Vltava (Moldau) River, which is navigable at this point. The city has a large ring-place surrounded by arcades, a park with monuments, a 16th century cathedral, a Gothic Church of Our Lady, 1274, an episcopal residence, and a theater. This city has long been famous for its beer, and in the past decade has added many other manufactured products to its export list, the more important being matched wood, cellulose, pottery, china and chemicals. Its central position makes it an important rail terminal, and the navigability of the Vltava makes it a center for the transshipment of heavy freight. Budějovice was laid out by King Ottocar II in 1265 and made the seat of a bishopric in 1783 by Emperor Joseph II. Pop. 1929, about 52,000.

**BUDENYI, SIMEON MIKHAILEVICH** (1881- ), Russian general, son of peasants. He entered the army in 1903, became a non-commissioned officer, fought in the World War, joined the Bolsheviks in 1918 and formed the Red Cavalry which he led against Denikin in 1919 and against the Poles in 1920. In 1921 he became chief of all the Soviet cavalry and later a member of the Supreme Council.

**BUDGE, SIR ERNEST ALFRED WALLIS** (1857- ), English archaeologist, born in Cornwall, July 27, 1857. He studied at Christ's College, Cambridge, specializing in Assyrian and Hebrew history and languages in preparation for the excavations he later made at Assuan, Egypt, at Nineveh and Der, Mesopotamia, and in the Sudan. He also made excavations at Gebel Barkal on the Island of Merve, the site of the capital of ancient Ethiopia. In 1893-1924, he was keeper of Egyptian and Assyrian antiquities for the British Museum and produced a remarkable number of books and pamphlets on archaeology, including *Babylonian Life and History*; *Egyptian Ideas of the Future Life*; *The Gods of Egypt*; *The Nile*; *The*

*Egyptian Sudan*; and *The Queen of Sheba and Menyelek*.

**BUDGET**, as applied to government or business administration, a formal plan of action involving the making of estimates of income, earnings, and receipts set over against similar estimates of expenses, costs, and expenditures for the purpose of intelligent action in the administration of the enterprise. All administration requires planning ahead. The term budget is not applied to such plans unless formally organized, coordinated, and adopted as a company plan of action. The budget is composed of the various departmental budgets which are then consolidated into a master budget. Thus, the sales budget, drafted by the sales department and covering an estimate of future sales during a definite period together with an estimate of relative selling expenses, is usually the basic budget on which the production, purchasing, advertising, general administrative, financial, and other budgets rest. These, when coordinated and consolidated, become the master budget. See also **BUDGET, NATIONAL**; **BUDGETARY CONTROL**.

**BUDGET, BUREAU OF.** See **TREASURY DEPARTMENT, UNITED STATES**.

**BUDGET, NATIONAL.** The pressing need for a national budget system in the United States was pointed out by President H. W. Taft's Commission on Economy and Efficiency in 1912, but Congress took no action at that time. It was almost a decade later that national budgetary legislation was passed. The so-called budget and accounting act became law on June 10, 1921.

This act makes the President responsible for submitting to Congress each year a complete budget for the national government. To assist him in the preparation of the budget, the act creates a Bureau of the Budget, headed by a Director of the Budget. While this bureau is nominally under the **TREASURY DEPARTMENT**, it is actually attached to the President's office. The director is appointed by and serves at the pleasure of the President.

Aside from the formulation of the budget for the President, the main duty of the Director of the Budget and his staff is to keep a record of quarterly allotments of the **APPROPRIATIONS** expended by the various departments and agencies of the government and to advise the President on the rate of expenditure. Certain coordinating machinery has been set up under the Director of the Budget, which is designed to foster economy in governmental operation and to standardize practice and procedure.

The budget and accounting act also establishes a General Accounting Office, under an officer known as the Comptroller General. This officer is appointed by the President for a term of 15 years, and is removable only by a joint resolution of Congress or by impeachment. He is therefore practically independent of the executive. His principal duties are to control the treasury receipts and issues, and to settle and adjust all claims either due or against the national government. In the discharge of his duties,

he must make numerous rulings on the expenditure of funds which have on several occasions been the subject of court action brought by the spending agencies of the government.

To enable Congress to deal with the budget more effectively, each house has consolidated its various committees handling appropriations into a single committee on appropriations. Since these committees are rather large, they operate through a number of subcommittees.

In developing the national budgetary procedure, the phase relating to the execution of the budget is the most backward. This is due to several causes, chief among which are that the Bureau of the Budget is legally without power to see that the budget is properly executed, as the Bureau must rely entirely upon the departments and agencies to carry out the expenditure plan of the government; and, secondly, the President does not have a central accounting and controlling agency under his direction and must depend upon an independent agency, the General Accounting Office, for this work. See also **BUDGETARY CONTROL**.

A. E. B.

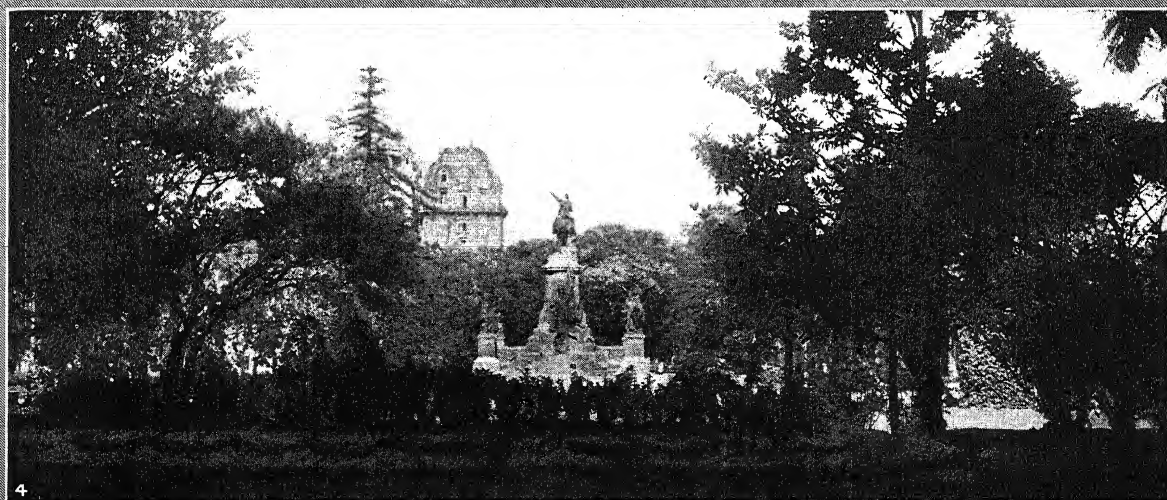
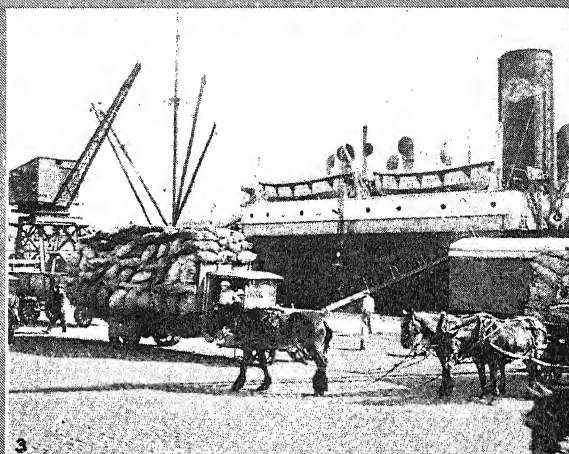
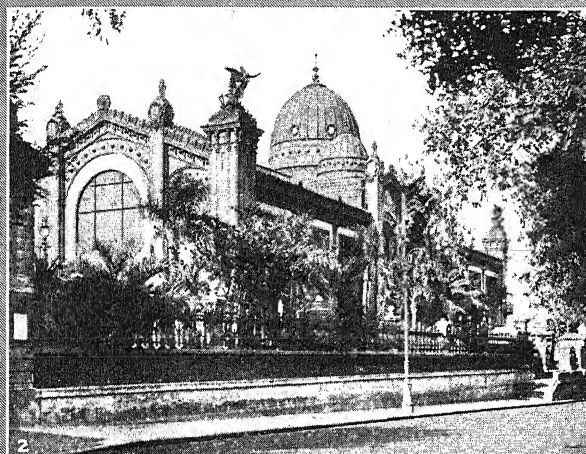
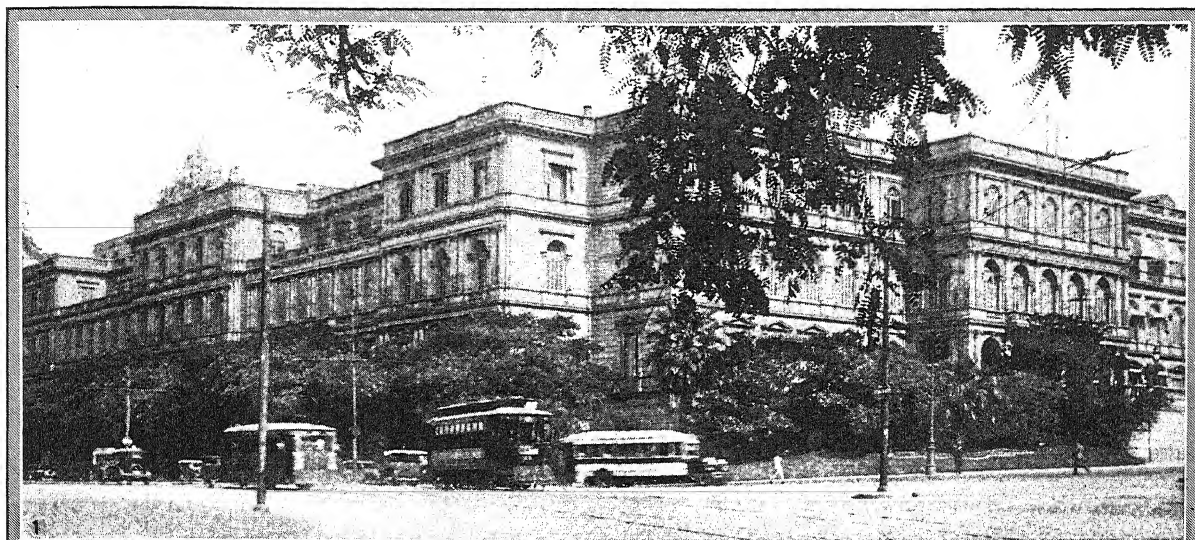
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**BUDGETARY CONTROL**, a system or plan of administrative control by means of **BUDGETS**. The various departmental budgets, as adopted represent the best official judgment as to a reasonable expectation of income, expenses, and costs for the budget period. These budgets set a goal to be attained. A comparison of actual results with those planned provides a measure of efficiency of those executives responsible for the various activities. While major functional or departmental responsibilities are covered by departmental budgets, it should be emphasized that, if the best results are to be secured from budgetary control, the detailed categories of each departmental budget should be set up according to the various divisional activities over which it is desired to secure control. No executive should be held responsible for activities over which he does not exercise control. Divided control means divided responsibility which destroys the basis of real control. Inasmuch as the budget requires information under certain categories, arranged according to responsibilities, it follows that the system of records must always be carefully coördinated with these budgetary categories so that there will be a continuous flow of information showing the accomplishment at any time. Flexibility is a necessary characteristic of a budgetary system. There must be a constant revision of future plans and estimates in the light of accomplishment. The essential features of budgetary control are therefore threefold: (1) the preparation of departmental budgets according to responsibilities; (2) the coördination of these into a master budget; and (3) a system of reports to officers and executives to give a comparison between actual and planned performance. See also **GANTT CHARTS**.

R. B. K.

**BUDWEIS.** See **BUDĚJOVICE ČESKÉ**.

## BUENOS AIRES



COURTESY MINISTER OF AGRICULTURE, ARGENTINE REPUBLIC

### SCENES IN THE ARGENTINE CAPITAL

1. Government House seen from Rivadavia Street. 2. View of the Museum of Fine Arts.  
3. The busy port, where ocean liners from all parts of the world dock. 4. The magnificent San Martín Plaza in Buenos Aires.





**BUENA VISTA**, a city in Rockbridge Co., western Virginia. It is situated on the north branch of the James River, 50 mi. northeast of Roanoke, Va., and is served by bus lines and two railroads. Tobacco, grain and fruit are raised in this region; paper, silk, leather and fire brick are the local manufactures. Buena Vista is the seat of the Southern Seminary for girls. The city was founded in 1890 and incorporated in 1892. Nearby is the Natural Bridge of Virginia. Pop. 1920, 3,911; 1930, 4,002.

**BUENA VISTA, BATTLE OF**, Feb. 22-23, 1847, one of the chief engagements in the Mexican War, which resulted in the most brilliant American victory of the war, characterized as the triumph of the common soldier. Santa Anna, who had seized the reins of government in Mexico, learned by intercepted dispatches that Taylor had been left at Monterey with less than 5,000 soldiers, including only 453 regulars, the remainder of the American army having been diverted to the seacoast to meet Gen. WINFIELD SCOTT. Taylor, disobeying instructions, advanced from Monterey to Saltillo. Santa Anna advanced toward this point with 20,000 troops. Having been advised of this movement by his scouts, Taylor moved to a strong defensive position at Buena Vista, seven miles south of Saltillo, and awaited the attack. The battle was begun on the afternoon of the 22nd and continued with slight intermissions throughout the next day. The artillery companies and the Mississippi regiment under JEFFERSON DAVIS especially distinguished themselves. Santa Anna was forced to retire with a loss of 2,000 men; the American loss was 264 killed and 500 wounded.

**BUENOS AIRES**, the capital and chief port of Argentina, South America, situated near the head of the Rio de la Plata, 125 mi. from the open sea and 5,870 mi. from New York. By reason of its manifold functions as port, federal capital, and financial and social center, Buenos Aires has experienced a remarkable growth. Now the third largest city in the Americas, its population in 1930 totalled 2,153,200. In 1895, the inhabitants numbered 663,000, as against 90,000 in 1855. One-fifth of the population of Argentina resides in Buenos Aires. Within the lifetime of the people still living, it has become a city of great wealth, of beautiful avenues, parks, residences and suburbs, of expensive and extravagant living on the one hand and of poverty on the other. It is relatively free from smoke and has all the most modern utilities.

Buenos Aires was built according to the practical Spanish system of civic planning; a big square was the nucleus, with the cathedral and subsidiary buildings, the governor's palace, the offices of the town council, *cabildo*, and attendant edifices, ranged on the sides; streets led from the corners of the plaza which were crossed by others and extended indefinitely as the city grew. Because of the congestion at Buenos Aires during the busy months, the city has lost some of its export trade, though it still retains supremacy as a receiving port. ROSARIO, affording

better access to the most productive cereal districts, has taken over the exporting of most of the wheat, corn and flaxseed. For the Pampa region of Argentina an even more auspicious advantage than the rail system lies in the favorable proximity to the sea. Only by the accessibility of cheap sea transportation could the region have captured world markets. Moreover, the great river artery of the Paraná provides direct ocean services for the richest corn and wheat districts. The paucity of harbors has made port establishment difficult in most cases, and the needs of commerce keep dredges working continually in such ports as are available.

Buenos Aires has a particularly poor harbor owing to the enormous deltaic deposits of the Paraná River; nevertheless, the port handles half the commerce of Argentina and has facilities for loading and discharging 1,500 vessels at the same time. The docks are of the most modern basin type, equipped with warehouses and elevators and served by many railway lines.

Industries other than the special ones concerned with the preparation of meat in freezing works and with the milling of wheat, were not of much importance until recently, though numerous articles of domestic consumption were made on a small scale. Since the World War, the growth of manufacturing has been enormous, and there are more than 11,000 industrial plants. The by-products of the flour mills and dairies are shipped to Europe. Furniture manufacture is important.

The tramways and subways of Buenos Aires are noteworthy, the tramway system being called the best in the world. There are 500 miles of lines, carrying about 400,000,000 passengers yearly. Overcrowding is not allowed, the number of passengers per car being strictly limited. The subway carries 2,500,000 people annually and maintains excellent freight service.

**BUER**, formerly a German city in Rhenish Westphalia, about 20 mi. west of Dortmund. It was united on Apr. 1, 1928, with GELSENKIRCHEN and Horst and became Gelsenkirchen-Buer. Pop. 1925, 99,058.

**BUFFALO**, the 2nd largest city and port of entry of the State of New York and 13th metropolis of the United States, is situated at the eastern end of Lake Erie, at the head and on the east shore of the Niagara River, a boundary between the United States and Canada, and at the western end of the New York State Barge Canal. It is at 42° 53' N. lat. and 78° 55' W. long., 24 mi. south of Niagara Falls, 297 mi. west of Albany and 425 mi. northwest of New York City. Buffalo has an area of 42,894 acres. In 1920 its population was 506,775; in 1930, 573,076. The city is the seat of Erie Co. Buffalo records an average temperature of 24.6° F. in January, of 69.8° F. in July. The average annual precipitation is 36 in.

**Geographic Setting.** Buffalo was originally settled at the mouth of Buffalo Creek, a stream emptying into Lake Erie. The modern city has extended north along Niagara River and east to a plateau be-

tween 50 and 80 ft. above the lake and 620 ft. above sea level. The excellent site drains into the swift Niagara River, the chief outlet of the four upper Great Lakes. The original town was laid out on a rectangular plan, to which modern surveyors have largely adhered.

**Streets and Buildings.** The southeast direction of the lake front necessitated an occasional departure from the direction of the streets following the cardinal points of the compass, and Delaware Avenue, Genesee Street and Broadway, for example, cut intersecting streets on a diagonal. In these few instances the effect is a pleasing variation of the generally logical arrangement of the city. Of the 600 mi. of streets in Buffalo, the most important thoroughfares are Main, extending north and northeast from the harbor through the business section to the city limits; its parallel, Delaware Avenue; Niagara Street, running north and northwest along the river front as far as Tonawanda, a large suburb; and Broadway, running from the business district east and northeast to the east line of Buffalo. Among the chief residential streets, lined with gardens and shrubs, are North and Delaware avenues. The residential district is chiefly in the northern sections of the city. In the retail district the chief buildings are the Marine Trust Building, the Buffalo Chamber of Commerce, the Liberty Bank, the Rand Building, Ellicott Square, Manufacturers' and Traders' Trust Building and the structure of the New York Telephone Co. The outstanding public buildings are the Federal Building, County Hall, the three state armories and the white marble Albright Art Museum and the Historical Building in Delaware Park. The new City Hall in Niagara Square, the civic center, cost \$7,000,000 and is flanked and faced by new county and state buildings. A chain of recreation grounds covering an area of 1,342 acres and surrounding the city make up Buffalo's municipal park system. Chief among them is Delaware Park, 365 acres, in 1901 the site of the Pan-American Exposition. The noteworthy monuments include the MCKINLEY MEMORIAL, a marble shaft in Niagara Square; the Soldiers' and Sailors' Monument to the Civil War dead in Lafayette Square; and the figure of Com. Oliver H. Perry at The Front, a bluff 60 ft. high at the point where Lake Erie flows into the Niagara.

**Commerce and Industry.** The location of the city, and its facilities for rail and water communication, have made Buffalo the 8th largest manufacturing city in the United States. These manufactures, among which are flour and grain products, rubber, iron and steel, and meat products, were valued in 1929 at more than \$720,000,000. The same year the retail trade amounted to \$346,447,020. In 1929 the wholesale trade, all establishments, of the city of Buffalo together with Erie Co. amounted to \$681,895,546. The harbor of 680 acres, enclosed by a Federal breakwater, and the water frontage, 38 mi. long, flanked by municipal and private piers, grain elevators and warehouses, give to Buffalo its high rank

as a port. In 1929 foreign exports totalled 728,101 tons and foreign imports 2,464,750 tons.

Transportation by rail is provided by the New York Central, Erie, Lehigh, Pennsylvania, Michigan Central and six other carriers. The Municipal Airport covers 555 acres, and a marine airport has also been built.

**History.** The first white settler of Buffalo was a French fur-trader of noble birth, Lieut. Daniel de Joncaire, who built a trading post and plantation at the mouth of Buffalo Creek. The name of the settlement derives from the creek, named, it is believed, after the herds of bison which early travelers are thought to have found in the locality. During the War of 1812, Buffalo was the center of frontier conflict, and in 1813 was burned by the British. In 1816 Buffalo was incorporated as a village, in 1832 as a city. Buffalo celebrated its centennial in the summer of 1932. Two Buffalonians went to the White House: Millard Fillmore in 1850, Grover Cleveland in 1884 and 1892. President William McKinley was assassinated there in 1901, and Theodore Roosevelt, who succeeded him, took his oath of office in a Buffalo residence.

**BUFFALO**, a name applied to various large animals of the ox group and also to certain African antelopes. Throughout North America the bison is popularly called buffalo. In a stricter, more accurate sense the name belongs to the water buffalo, still found wild in India and widely domesticated in the warmer parts of the Old World. Closely allied to the foregoing is the Cape buffalo, a large, powerful animal formerly abundant in South Africa, where in many districts it has been hunted to the verge of extinction for its thick, strong, valuable hide. *See also* BISON; WATER BUFFALO.



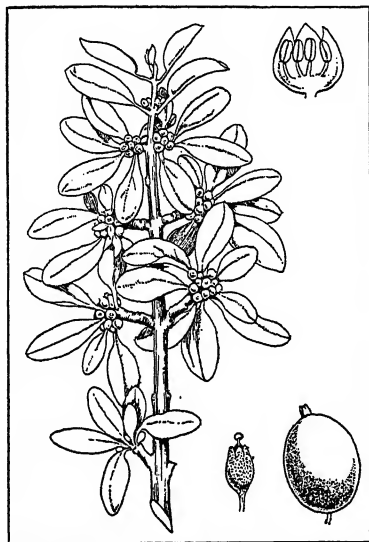
COURTESY AMER. MUS. OF NATL. HISTORY

AFRICAN OR CAPE BUFFALO

**BUFFALO, UNIVERSITY OF**, at Buffalo, N.Y., a coeducational, non-sectarian and privately controlled institution, chartered in 1846. Until 1886, the School of Medicine constituted the university. Since then it has developed complete arts and sciences courses.

it has an endowment of \$4,300,000. The library contains 62,153 volumes. In 1930 there was a student enrollment of 3,244, and a faculty of 383 headed by Chancellor SAMUEL P. CAPEN.

**BUFFALO BERRY** (*Shepherdia argentea*), a handsome, somewhat thorny shrub of the oleaster family found from Minnesota to Saskatchewan and



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

**BUFFALO BERRY**

Staminate flowering branchlet, pistillate flower, fruit and longitudinal section of staminate flower (upper right)

northward to Kansas and Nevada. It grows 3 to 18 ft. high, bearing silvery leaves, inconspicuous yellowish flowers, and red or yellow edible berries. The plant is cultivated in the Northwest where the acid fruit is much used for jellies.

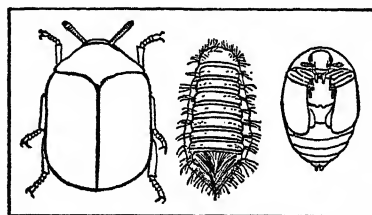
**BUFFALO BUR** (*Solanum rostratum*), an intensely spiny annual of the nightshade family called also sandbur and prickly POTATO. It is native to prairies from South Dakota to Texas and Mexico and more or less diffused as a weed eastward to New Hampshire and Florida. The erect stem, 1 to 2½ ft. high, bears numerous branches, irregularly lobed, potato-like leaves, showy yellow flowers and an exceedingly prickly, burlike fruiting calyx enclosing a many-seeded berry. The buffalo bur is the original host plant of the destructive COLORADO POTATO BEETLE (*Leptinotarsa decemlineata*). See also SOLANUM.

**BUFFALO FISH**, a genus (*Ictiobus*) of large fresh-water food fishes of the sucker family (*Catostomidae*), found most abundantly in the rivers of the Mississippi Valley. In form they are rather stout and carplike, with a large mouth and thick protractile lips. They live near the bottom, feeding on aquatic vegetation and small animals. The common buffalo fish (*I. cyprinella*), brownish-olive in color, grows 3 ft. long and sometimes weighs 50 lbs.; the small-mouth buffalo fish (*I. bubalus*) reaches 3 ft. in length and a weight of 35 lbs.; while the black buffalo fish (*I. urus*) is larger but less common than either of the

foregoing. Although their flesh is rather coarse and inferior large quantities are used for food. The annual commercial catch usually exceeding 17,000,000 lbs., is valued at about \$1,000,000.

**BUFFALO GRASS** (*Bulbils dactyloides*), a valuable fodder grass found on plains and prairies from Minnesota and Saskatchewan southward to Texas and Mexico. It is a low perennial with strong fibrous roots, producing a tough sod. When unmixed with other grasses it forms a very close, soft, gray-green turf. It covers large areas on the uplands known as the "short grass country," where it is the most important grazing grass. The sod houses of the early settlers were built chiefly from the sod of this grass.

**BUFFALO MOTH**, a larva of a beetle, although commonly called either a moth or a bug. It infests



**BUFFALO MOTH OR. MUSEUM BEETLE**  
(*Anthrenus musæorum*). Adult, larva and pupa, enlarged

carpets, furs and woollens, and is a well-known household pest. The larvæ, not the beetles, do the damage. See CARPET BEETLE.

**BUFFALO PARK**, a Canadian national park at Wainwright in western Alberta, established Mar. 7, 1908 to form a preserve for the American bison which were threatened with extinction. The government started with a herd of 700 bison which has increased to over 6,000, the largest herd in the world. Because of the great percentage of increase many have been shipped to other reservations and a fairly large number have been killed for meat and buffalo hides. The park also contains herds of mule deer, moose, elk, yak and a hybrid between the yak and domestic cow which have been crossed in an effort to produce a new type for use in the severe winters of the far north. The area of the park is 197.5 sq. mi. and is almost entirely enclosed. The park is reached by the Canadian National railroad and by an improved highway from Edmonton.

**BUFFER ACTION**, a phenomenon exhibited in chemistry when certain substances, added to solutions of acids or bases, materially inhibit the activity of reaction, although the buffer substances themselves do not take part in it. It has been explained on the basis of the ionic theory (see ION), whereby the activity of an acid, for example, is proportional to the number of hydrogen ions per unit volume of the solution. A buffer substance, then, is a compound whose molecules dissociate to only a limited extent in the solution, maintaining all the time an equilibrium between the ionized and un-ionized portion. The effect of this equilibrium of the buffer would be to

depress considerably the HYDROGEN-ION CONCENTRATION of any acid added, and thus, although not chemically interacting with the acid, it would reduce its activity to such an extent as to make the solution appear only slightly acidic. Among the more common buffers in chemistry are the salts of weak acids with strong bases, such as sodium acetate and phosphate. Buffer actions play an important rôle in nature, and in the vital processes, especially in the blood, where the presence of buffers enables comparatively large amounts of acid to be present without actually much changing the slightly alkaline reaction of the blood itself. A notable example of this is the action of orange juice and other citrous juices which are taken to reduce acidity in the system. W. J. L.

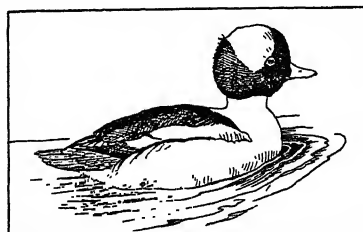
**BUFFER STATE**, a state set up consciously or by accident, between two rival nations, and which bears the burden of the opposing forces or prevents the forces from coming together. A buffer state may also be created to divide a former state against itself. The advocacy of France of a Rhenish republic was regarded as a proposed buffer state against a united and compact Germany. The free city of Danzig, separating East Prussia and Germany proper, is sometimes called a buffer state between Germany and Poland. Poland itself is regarded as a buffer state between Russia and Germany. Manchuria is sometimes called a buffer province between Russia, Japan and China proper.

**BUFFET**, a French term, applied to a piece of diningroom furniture of varied type. About the earliest recorded use of the term in English occurs in an inventory of 1600 listing "two court buffet cupboards with low bottoms." THOMAS SHERATON in his *Cabinet Dictionary* of 1802 defines it as "a piece of furniture with cupboard doors in the lower portion and tiers of shelves above." In the medieval hall, the buffet, by whatever name it was known, apparently preceded the dresser. It was a highly decorative and conspicuous object, elaborately carved and often draped with white damask.

**BUFFING**, a process of finishing metal surfaces by using a wheel run at a high speed on the surfaces. Buffing wheels are usually made of cloth and are frequently called "rag" wheels. In nearly all cases the metal is first smoothed by a polishing wheel, which is covered with ABRASIVE material. The last polishing is frequently called "fining." Irregular surfaces are often polished by the use of endless straps or belt, covered with an abrasive. These straps run at high speed and can be worked into small spaces that cannot be reached with a polishing wheel. See GRINDING MACHINES.

**BUFFLEHEAD** (*Charitonetta albeola*), a small, open-water duck closely allied to the GOLDEN-EYE, called also butter ball and spirit duck. The bufflehead is widely distributed in North America, nesting chiefly in Canada and Alaska and wintering southward as far as Mexico and Florida. It is about the size of the teal, the male having a black back, white underparts and a glossy blue-black head marked with white, the

size of which is greatly exaggerated by the length of the feathers. This duck is a remarkably expert diver, seeking its food of aquatic plants, crustacea and small fish under water. It nests in hollow trees, laying 6 to 12 pale buff eggs.



DRAWING BY GEORGE MIKSH SUTTON

BUFFLEHEAD

**BUFFON, GEORGE LOUIS LECLERC COMTE DE** (1707-88), French naturalist, was born at Montbard, Sept. 7, 1707. He studied law at the College of Jesuits near Dijon but early showed a pronounced liking for natural science. Inheriting a fortune in 1732, the naturalist was able to follow out his own bent. In 1739 he became keeper of the King's Gardens and the Royal Museum. Ten years later Buffon began writing the *Natural History* for which he is famous. The first edition of this great work was put out in 44 volumes which appeared between 1749 and 1804, the last seven volumes being issued after the author's death. The work is particularly noted for its beautiful illustrations and marks the beginnings of a scientific approach to natural history. In it are put forth evolutionary ideas, special emphasis being placed upon the factor of climate in determining the development and distribution of species. One of its weaknesses is hasty generalization. Buffon was a member of the leading scientific societies of his day. He died in Paris, Apr. 16, 1788.

**BUG**. Strictly speaking, the term bug is limited by entomologists to members of the orders *Hemiptera* (or *Heteroptera*) and *Homoptera*. Insects of both orders possess piercing and sucking mouthparts in the form of jointed beaks. In most cases the metamorphosis is gradual. This is, the young resemble the adult in general form of body and manner of life, and do not pass through a pupa stage. In a few highly specialized forms, metamorphosis is complete.

In the *Hemiptera* or true bugs (from the Greek, *hemi*-, half, and *pteron*, wing), the first pair of wings are thickened at the base. The thinner extremities of these wings overlap on the back. The order is a very important one. Here belong many pests of cultivated plants, such as the tarnished plant bug, apple red-bug, cotton stainer, chinch bug, squash bug and cabbage bug. The true bedbug is also of this order. Other species are very beneficial, because of their predacious habits. Such are the assassin-bugs, the masked bedbug hunter, and the ambush-bugs. Many aquatic insects are also included in this order, as the water boatman, giant water-bug and water-strider.

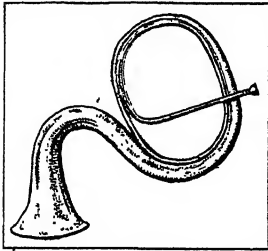
In the *Homoptera* (Greek *homos*, same, and *pteron*,

wing), the wings are uniform in texture throughout, and are usually held sloping over the back when at rest. Many wingless forms occur. This order likewise is of great importance, as it includes some of the most serious pests of agriculture. Leaf-hoppers, jumping plant-lice, aphids, scale insects, mealybugs, phylloxerids and white flies all belong here. Some beneficial insects are the cochineal scale and the lac-insects. Of less economic importance are the lantern-flies, tree-hoppers, cicadas and spittle insects.

The term bug is erroneously employed in common parlance to designate any insect. It may be used alone or with another word, thus, potato-bugs, bill-bugs and June-bugs are really beetles. The Croton-bug belongs to the order *Orthoptera*. J. R. T.

**BUGEYE.** See *BOAT*.

**BUGLE**, a brass musical instrument of the trumpet family, used chiefly in military music. The keyed-bugle, often known as the Kent bugle, is the type now in common usage. It has a compass of two octaves.



COURTESY M. M. OF ART

TENOR BUGLE IN B FLAT  
*Italian, 19th century*

**BUILDER'S LIEN**, a claim filed by the builder or contractor for moneys due for the construction of the property. It is regulated by STATUTES or city ordinances. See also MECHANIC'S LIENS.

**BUILDING AND LOAN ASSOCIATION**, a type of cooperative bank designed to promote savings for the purpose of acquiring homes. These associations originated in England early in the 19th century. Shares in a building and loan association are subscribed by the members and building loans can usually be obtained from the association up to the par value of the stock owned by the builder. See also COOPERATIVE BANKING; BUILDING LOANS.

**BUILDING CODES.** The larger cities have given much attention to the development of rules and regulations governing the arrangement and construction of buildings. For all important structures, plans must be submitted and approved. The size, shape and height of buildings must be such as to provide for certain minimum requirements relating to air and light for the occupants, as well as for the public and the adjoining property owners.

Cities are divided into residence, commercial, manufacturing and other "zones" in order that the property owners may be safeguarded against the erection of buildings that would cause a depreciation in values. In the more congested sections of the cities, the regulations restrict or forbid the construction of non-fireproof buildings so that the fire hazard may be reduced to a minimum. Standards are established for the quality of materials entering into the construction and rules are formulated for computing the strength of those portions of the building subjected to load.

Approved methods of providing for the fireproofing

requirements are set forth and in all cases where the building will have a considerable number of people occupying it, special provisions are made for adequate exits in case of fire or panic.

In general, codes relating to building construction have kept pace with the development of new materials and new methods of construction, as well as with the needs arising in the growth of large cities.

Organizations promoting the use of certain building materials, notably structural steel and cement; civic organizations, such as CHAMBERS OF COMMERCE, interested in the adoption of zoning regulations; and especially insurance companies concerned with the reduction of fire risk, have been powerful factors in the development of building codes.

The smaller cities have followed the example of the large cities and have adopted such code provisions as are applicable to them.

G. A. H.

**BUILDING CONSTRUCTION.** Modern American buildings have surpassed any construction of preceding epochs. Now it is possible to erect a business building of heights up to 1250 feet, as e.g., the Empire State building in New York City, the tallest structure ever built by man. It exceeds in height the Eiffel Tower of Paris by about 25%. Only with very high speed elevators can the top 30 or 40 stories prove to be a paying investment, even under the best conditions and with the maximum demand for space. The maximum economic height of business buildings, hotels, and apartment houses may be considered as 40 stories, although many much higher will probably be erected for purposes of publicity.

The fundamental necessity of such buildings is a first class foundation, such as is afforded by the bedrock of Manhattan Island. But in many cities soil conditions limit the heights to 30 or 40 stories. The possibility of *earthquake* shocks in almost any part of the world is most important in determining the height and design of tall buildings. The traffic congestion caused by a number of high buildings in any locality should also, for business reasons, be given consideration. Engineering design offers no obstacle to erecting buildings much higher than 1250 feet.

The design of the steelwork (see SKELETON CONSTRUCTION), must not only provide for the vertical loads, but full account must be taken of the effect of high winds or excessive forces of any kind. The protection of the metal work against CORROSION must be fully provided for. The use of re-enforced concrete (see CONCRETE, RE-ENFORCED) floors, adds greatly to the stiffness of tall buildings. The tapering of the building towards the top, where not controlled by the BUILDING CODE, must be a matter of co-operation between the engineer and the architect, as light and air are factors of great importance.

For the design of steel and mill buildings, see also FACTORY CONSTRUCTION. C. E. F.

**BIBLIOGRAPHY.**—M. Merriman, *American Civil Engineers' Handbook*, 1930; A. H. Heller, *Stresses in Structures*, 1916.

**BUILDING INSPECTION**, is necessary during construction in order that local municipal authorities



may be assured that buildings are being erected in accordance with law and regulations and with due regard for safety during construction and after completion.

Municipal building inspectors should be competent structural engineers and should, of course, be familiar with the provisions of the local building code and regulations relating to the inspection of buildings.

Besides the inspectors appointed by the local authorities, others are often appointed by the owner or architect in order that assurance may be had that the building is being erected in accordance with plans and specifications and that the materials (*see BUILDING MATERIALS*) being used meet the necessary requirements.

Those employed as building inspectors by the owner or architect should be competent structural engineers with a knowledge of mechanical engineering in cases where the project is not large enough to justify the employment of a structural engineer and a mechanical engineer. On large projects it is now customary to employ both.

The various materials used in construction, such as cement, structural steel, and reinforcing steel, should be tested in accordance with recognized engineering standards. Facilities for these tests are now available in research laboratories in various parts of the country. Physical tests of some of the materials may be made on the work by the inspector. Testing material specifications are standard and may be procured from American Standards Association and American Society of Testing Materials.

During the course of erection, the building should be examined daily by the inspector in order that he may have an intimate knowledge of each part of the work as it progresses. In the event that it is discovered that any part of the work is defective, or that any of the material being used is not in accordance with specifications, the matter should be reported without delay by the inspector to the proper authorities with a view to having the conditions remedied if the defects are in construction, or, if necessary, arranging for a test of the materials. J. F. G.

**BUILDING LAWS**, legislative restriction upon the property owner's right to build as and how he pleased began with the proscription within certain areas and defined districts of so-called nuisance occupations. Then came fire zone regulations restricting building with inflammable material; then, building codes stipulating the minimum strength and carrying power of beams, girders, rafters and frame work, regulating height, methods of construction and adjoining areas which must be left open. Building codes, sanitary codes and tenement house codes, calling for the filing of building plans with some public authority and their approval are now general in municipalities throughout the United States.

Zoning laws are the most modern reaction to the congestion and the haphazard growth of cities. They involve, essentially, the creation and maintenance of residential districts from which business and trade of

every sort including hotels and apartment houses are excluded. The advantages of such legislation, enforced by an appropriate local administrative body are, briefly, that they stabilize real estate values, control and direct community growth, eliminate waste in city management and promote the possibility of aesthetic development. Zoning acts have been sustained by the Supreme Court of the United States as valid exercises of local police power. N. G.

**BIBLIOGRAPHY.**—J. Metzenbaum, *The Law of Zoning*, 1930; N. F. Baker, *The Legal Aspects of Zoning*, 1927.

**BUILDING LOANS**, loans made to persons for the purpose of erecting buildings on land owned or leased by them. The contract contains the statements, including estimated costs, that the borrower owns or has leased the land. A mortgage is given which covers the land and structure. Interest is high, for in case the borrower fails, the loan company, for its protection, is forced to foreclose the mortgage and complete the building.

**BUILDING MATERIALS.** New uses for existing materials as well as the development of new materials has revolutionized building construction in a relatively few years. Not many years ago residential buildings, except for the larger and more pretentious ones, were built of wood, and manufacturing and commercial buildings had wood floors supported on bearing walls of brick.

Today many private residences and nearly all multiple story residence buildings are of fireproof construction. The commercial buildings have fireproof **STRUCTURAL STEEL** frames and thin walls supported at each floor line upon the steel construction. The large manufacturing and storage buildings are usually of re-enforced concrete.

The introduction of the structural steel frame enclosed in fireproof material supporting fireproof arches of brick and **TERRA COTTA** and supporting the exterior wall at each floor line, marked a great advance in building construction. This has been followed by the use of cinder concrete arches and fireproofing in New York City; and the use of stone concrete for similar purposes in other cities. This type of construction has been used extensively for all so-called high buildings, including commercial buildings, apartment houses, hotels, public buildings, and the like. The use of wood floors and brick walls for manufacturing and storage buildings has been, to a large extent, superseded by the use of re-enforced concrete.

Heavy loads due to the increased height of the newer buildings constructed with skeleton frames has necessitated the adoption of new types of foundations involving the use of concrete **CAISSONS**, extended down, in many cases, to bedrock.

**GYP-SUM** and clay **TILE** have been developed to provide noncombustible and fireproof partitions of light weight. Clay tile and concrete tile are frequently used in combination with brick to provide a light-weight water-tight wall in place of the solid brick wall.

A floor construction consisting of metal lumber

made of light rolled steel shapes, floored over with a concrete slab and having a plaster ceiling, is being quite generally used and provides a semi-fireproof floor in place of the all-wood floor construction formerly used. Terra Cotta, ceramic tiles and natural and artificial stones, also are used extensively in the modern building. The use of aluminum and CHROMIUM STEEL for structural and decorative purposes in connection with building construction is a recent development. For the description of special building materials, refer to the particular title. G. A. H.

**BUITENZORG**, a city of Java, Dutch East Indies, situated on a hill about 40 mi. south of Batavia, with which it is connected by rail. It is the residency of the governor-general of the Dutch East Indies and contains a number of impressive public and private buildings. The botanic gardens are considered among the most beautiful in the world. Rice, rubber, tea, sugar-cane, spices and coffee are the chief articles of trade. Pop. 50,000.

**BUKHARA.** See BOKHARA.

**BULAWAYO**, a town of Southern Rhodesia and an important railroad center 250 mi. southwest of SALISBURY. It is situated on a plateau in Matabeleland, about 4,450 ft. above sea level. It is the headquarters of the Rhodesian railways and the gateway to Rhodesia from the south. The railway from Bulawayo to Cape Town, 1,360 mi. long, is operated by the South African railways and the journey is now performed in less than three days. The town is the seat of the Rhodesian Museum, and is a market center with minor activities in milling, cotton-ginning and tobacco manufacture. Est. pop. 1930, 25,000, including 10,600 Europeans.

**BULBULS**, a large family (*Pycnonotidae*) of small birds closely allied to the thrushes, found in southern Asia and Africa. They are about 8 or 9 in. long, often with crests and conspicuous long hair-like feathers on the back. Their plumage is predominantly olive although in some species it is black or blue with brilliant markings. Bulbuls are mostly gregarious, frequenting trees and feeding upon fruits, seeds and insects. They build flimsy nests in bushes, laying pinkish or greenish variously marked eggs. The Madras bulbul or Ceylon nightingale (*Molpastes fuscus*), common throughout India, and the Palestine bulbul (*Pycnonotus xanthopygus*), of Syria and Arabia, have an exceedingly sweet song. Among the handsomest is the green bulbul (*Chloropsis aurifrons*) of southern Asia, with grass-green plumage variously marked with blue and orange-yellow. The bulbul celebrated in Persian poetry is probably a true nightingale (*Daulias hafizi*).

**BULFINCH, CHARLES** (1763-1844), perhaps the earliest American architect, was born August 8, 1763, at Boston. He studied at Harvard University, in France and in Italy. His first work was the design and construction of the Doric column, substituted for the old wooden light-standard on Beacon Hill. In 1795 Bulfinch laid the cornerstone of the State House in Boston. In 1818 he was appointed suc-

cessor to B. H. Latrobe as architect of the Capitol in Washington. The rotunda, portico, and west approaches are his work. Other works include the McLean Hospital, Somerville, Mass.; the General Hospital, Boston, and about forty churches and public buildings in New England. He died at Boston April 15, 1844.

**BULGARIA**, an independent Balkan kingdom of 39,814 sq. mi. bordering on the Black Sea and the Danube, and bounded by Yugoslavia on the west and Greece and Turkey on the south. The lower Danube for the most part forms the border-line between Rumania and Bulgaria.

**Surface Features.** Lengthwise through the middle of Bulgaria, from the Yugoslav border to the shore of the Black Sea, over a distance of some 350 mi., runs the Balkan Mountain range, dividing the country into two distinct geographical regions. Though rising to a height of 8,000 ft., the Balkans resemble upland slopes rather than steep mountains. The rounded peaks are wooded. Beech and oak forests cover the slopes, while the many depressions protected from the winds in winter are dotted with towns and villages engaged in manufacturing, agriculture and livestock-raising. The plateaus offer rich pasturage and the forests give employment to thousands of charcoal burners.

Directly south of SOFIA, the capital, rises Mt. Vitosha, with its summit, the Black Peak, reaching a height of about 7,500 ft. From here continue the Rilo Mountains and the Rhodope chain. Mousala Peak of the Rilo Mountains is 9,600 ft. above sea level, the highest peak in the Balkan Peninsula after Mt. Olympus. The shoulders of the Rilo and the Rhodopes are thickly wooded with pine, oak and beech, but the peaks, unlike those of the Balkan Range, are steep and rocky. Just west of the Rhodopes, divided by the plain of Bansko and Mehomia, is Mt. Pirin, its peaks rivaling in height those of Rila. Mt. Pirin is noted as the seat of storms, El-Teppe, one of its tallest summits, meaning in Turkish "peak of storms." The climate in the region north of the Balkan chain is severe, while southern Bulgaria, protected from the northern winds by this mountain range, enjoys a Mediterranean climate. From the foot of the northern stretches of the Balkans along the entire length of the country is the Danubian plain, the great wheat- and cattle-producing district of Bulgaria. A large number of rivers, all of which, excepting the Isker, have their sources in the slopes of the Balkans, run like arteries through this fertile plain and empty in the Danube. Chief among these rivers are the Lom, which feeds the Danube near Ruschuk, the Yantra, rising in the Balkans above Tirnovo, and the Ossum. The Isker, the largest to traverse the plain, has its source in the Rilo Mountains on the south side of the range. To reach the plain this river cuts through the famous Isker Defile, just north of Sofia. The only other important river of northern Bulgaria is the Kamtchia. Instead of moving from south to north, the Kamt-

chia follows an eastern course and flows into the Black Sea south of Varna. The rivers of southern Bulgaria, the principal ones of which are the Maritsa, the Struma and the Mesta, all empty into the Ægean after traversing the narrow strip of Greek littoral that shuts out Bulgaria from that sea. The MARITSA, with sources in the Rilo Mountains, is fed by numerous tributaries and runs in a southeasterly direction through the fertile valley to which it has given its name. The Mesta likewise rises in the Rilo Mountains and flows south to the Ægean near Kavala. The westernmost of the Bulgarian rivers is the Struma. It has its source in Mt. Vitosha, and runs close to the Yugoslav border. It reaches the Greek boundary near Petrich and after passing a swampy region in Greek Macedonia falls into the Ægean near Salonika.

**Religion and Education.** The Greek Orthodox is the national religion of Bulgaria. In 1925 there were 4,000,000 members of this church, 700,000 Muslims and 35,000 Roman Catholics. Until 1870 the Bulgarian church was part of the Orthodox Communion and subject to the jurisdiction of the Greek patriarch of Constantinople. In that year it ceded from the patriarchate and established its own religious head, the Exarch. The church is governed by a synod of bishops in Sofia, but the Exarchate is located at Constantinople. The country is divided into eleven dioceses with bishops in Varna, Sofia, Philippopolis, Stara Zagora, Sliven, Ruschuk, Tirnov, Vratza, Lovetch, Vidin and Nevrokop. There were four Bulgarian bishoprics in Macedonia and one in Thrace, but following the dismemberment of Macedonia in 1913 the Greek and Serbian governments closed the Bulgarian churches and expelled the bishops. In Sofia there are two cathedrals, the Sveti Kral and the Alexander Nevsky, the latter the largest Greek Orthodox cathedral outside of Russia. It was built at the beginning of this century by funds raised by popular subscription to commemorate the dead fallen in the Russo-Turkish war of liberation. Of the monasteries the largest is the Rilo Monastery, picturesquely situated in the Rilo forests. It was founded 1,000 years ago by St. John of Rilo, the patron saint of Bulgaria. For many centuries it has been a religious shrine.

Half a century ago, under the Turks, the Bulgarians as a people were practically illiterate. Since that time they have shown a remarkable zeal for education. Illiteracy has now been almost wiped out. The Bulgarian school system has been pronounced by European and American experts as one of the finest in the world. Education is free and compulsory for children between the ages of 7 to 14. There also are free public high schools, *gymnasiums*, and a large state university in Sofia. At Simeonov, a suburb of the capital, is the American College, until recently located at Somokov. In addition there are elementary American schools in Sofia itself, in Lovetch and in other Bulgarian towns. In 1929-30 the total attendance for all schools and colleges was 799,765.

**Production and Industry.** Agriculture is the chief occupation of the Bulgarian people. Thirty-five per cent of the surface of the Bulgarian land is arable, and three-fourths of the population is engaged in its cultivation. The land is owned by the peasants, except such tracts as are designated for communal pastures. The methods of agriculture are still primitive, the wooden plow and the ox-team being common. But tractors and harvesting and threshing machines are frequently seen, especially in the rich Danubian plain. Wheat, maize, barley, oats and rye are produced in large quantities. In 1929 Bulgaria produced close to 1,000,000 metric tons of wheat. The total grain production for the same year was over 2,500,000 metric tons. The climate of the country is particularly adapted to wine-growing. The total output of wine in 1929 was 17,000,000 gals. Fruit grows in abundance throughout Bulgaria, but the valley of the Maritsa and the neighborhood of Kustendil are richest. Immense quantities of plums are grown for the distillation of *slivovitza*, the national brandy. In the neighborhood of Philippopolis and more especially in Gorna Djumaia and Petrich the people are engaged in tobacco-growing, which for the last decade has been increasing rapidly, and in 1929 reached a total production of 10,000,000 lbs. In the valley between the southern slopes of the Balkan Range and the Sredna Gora chain, thousands of acres of land are devoted to the cultivation of the rose from which the famous perfume known as attar of rose is distilled. The distilleries to which the rose-growers cart the precious flower-petals are located at Karlovo, Kazanluk, Kalofer, Harmanlari and Sopot. At Stara Zagora some distillation of rose oil is also carried on. Rice and cotton are produced in the Maritsa Basin. Bulgaria is also rich in live stock. In 1920 there were 10,000,000 sheep in the country, more in proportion to the population than in any other European state. Horses, goats, swine and cattle are also raised in very large numbers.

The industries of Bulgaria are still in an embryo stage. Besides the distillation of attar of rose, flour-milling, spinning and weaving and cigarette manufacturing are the principal enterprises. At Gabrovo, in the heart of the Balkan Mountains, are the largest textile factories. There is also a spinning mill at Varna.

Bulgaria's mineral wealth is reported to be considerable. Like that of most Balkan states it is still far from fully exploited. The state owns three coal mines, the largest being the Pernik, located in the environs of Sofia. The total coal output in 1928 was about 1,500,000 metric tons, which was more than the country needed for its national consumption. Copper, lead and zinc are also mined, but in negligible quantities.

**Transportation and Trade.** The main ports of Bulgaria are Varna and Burgas on the Black Sea, and Ruschuk, Vidin and Lom on the Danube. In 1926 4,358 vessels entered the Black Sea and 11,274 the Danubian ports. Southern Bulgaria suffers from

the lack of an outlet to the Aegean Sea. During the BALKAN WAR, 1912, Bulgaria acquired access to the Aegean but in the World War she lost it to Greece, and, although the peace treaties provided for a Bulgarian outlet to the Aegean, the two countries have not been able to make satisfactory arrangements.

There are two main railway systems in Bulgaria, one lying on each side of the Balkan Mountains. Sofia is the western terminal of both these systems. The northern line passes the Balkan Mountains at the picturesque Isker Defile and after touching the principal towns of the Danubian plain reaches its terminal at Varna on the Black Sea. Numerous branches issue from this trunk line to Bulgarian ports on the Danube. At Gorna Orhovitza the railway from Ruschuk and Bucharest crosses the main line and connects with the southern system at Stara Zagora and with the Sofia-Constantinople route at Philippopolis. All of the railways, constituting a mileage of 1,500, are owned and operated by the state. In 1930 there were 10,000 mi. of state and communal roads in the country.

Bulgaria's chief export articles are tobacco, attar of rose, hides, eggs, wheat and maize. Twenty years ago wheat represented one third of the total export values, but in the last decade tobacco has been on the ascendant as an article of commerce. In 1929 it comprised approximately 40% of the export values of the country. Textiles, metals, mineral oils and machinery are the chief imports.

**Finance.** The financial activities of the country are in the hands of state institutions. The National Bank of Bulgaria, a government agency, is empowered to issue the national currency. Bulgaria has faced acute financial problems since the World War. The government has been unable to maintain a balance between revenue and expenditures and has frequently sought relief in foreign loans sponsored by the League of Nations. The revenue in 1925 was 6,650,000,000 *leva*, but the *lev*, the monetary unit of the country, which is normally worth twenty cents, had depreciated in value to less than one cent. The average value of the *lev* in the last five years has been 140 to the dollar.

**Government.** Bulgaria is a constitutional monarchy, governed by a hereditary king. The legislative power is vested in a single chamber, the *Sobranie*, or national assembly, of 227 members. The executive power is in the hands of a council of ministers, or cabinet, presided over by a prime minister. The members of the ministerial council are appointed by the king and are responsible both to him and to the *Sobranie*, whose sessions they must attend, since they are members of the *Sobranie* as well. The laws enacted by the legislative body require the sanction of the king and publication in the state bulletin. The king has authority to dissolve the *Sobranie* at will and to call for new elections, which must take place within two months from the dissolution of the legislative body. The *Grand Sobranie*, elected in the same way but with twice the number of members, is

convoked only when questions concerning the cession or acquisition of territories arise, when changes to the constitution are needed, or when throne vacancies must be filled. This assembly, according to provisions in the constitution, meets at TIRNOVO, the old capital of Bulgaria.

For the purpose of local administration the country is divided into sixteen departments, *okrugs*, administered by governors appointed by the minister of the interior. The *okrugs* are subdivided into *okoli* (counties) and *obshtini* (communes) which in turn are governed respectively by prefects and mayors. Juridically the state is divided in a similar manner. There are communal, county and departmental courts. The highest judicial body is the Court of Cassation in Sofia.

**Population.** Bulgaria takes a census regularly every five years. The census of December 31, 1926 gave the population as 5,483,125; in 1931 Bulgaria had 6,006,000 inhabitants. The country is divided into 16 departments, or *okrugs*, named after the chief towns. Sofia is both the capital of the kingdom and seat of the department of the same name. The city itself, according to the census of 1926, had a population of 213,000, that of the department was 642,135. The other chief cities of Bulgaria are PHILIPPOLIS, VARNA, RUSCHUK and BOURGAS. About 80% of the population is Bulgarian, the remainder principally Turkish. There are about 50,000 Jews.

**BULGARIA, HISTORY OF.** Related to the Magyars, Finns, Huns and probably to the Turks, the Bulgarian tribes came from Asia and settled in the 4th century between the Volga River and the Ural Mountains. Driven thence by the Avars, the Bulgars traveled southward toward the Danube, and from the lands north of that river made annual invasions into Byzantine territory. In 559 a troop of horsemen under Zabergan reached Constantinople, but were repulsed by BELISARIUS. However, in 679 the Bulgars crossed the Danube and subjugated the Slavs who had conquered previously the Illyrians and Thracians of the Empire. The Bulgars gave their name to the country, but adopted the language and customs of the Slavs. From this time until the 14th century the history of Bulgaria is the chronicle of a long struggle with the Byzantine Empire, during which the waning Empire was forced to make more than one concession to the fierce-fighting Bulgars. Not only did the Bulgars obtain the Roman province of Moesia, but tribute money as well.

The first great ruler of Bulgaria was King Krum, 802-814, who defeated the Imperial army in 811 and slew the Emperor Nicephorus, making his skull into a drinking goblet. Krum's son, Omortag, set up a monument to him on a towering rock outside the ancient capital, Madara, which is still visible. The next great ruler was Boris I, 852-893. He expanded the Bulgarian territories, and was the first Christian king of Bulgaria. Sometime between 860 and 870 the Bulgars were converted to Christianity by Catholic missionaries. Boris chose the Greek Church, probably

for political reasons, and after 893 lived in a monastery. He was later canonized. His second son, Simeon the Great, 893-927, succeeded him and ruled during the first golden age of Bulgaria. He led the people skillfully in war and wisely in domestic affairs, and sponsored the rise of arts and letters, he himself writing books in his native language. He extended his domains from the Adriatic to the Black Sea and from the Danube to the Aegean, and was successful in defeating the Roman Emperors, always exacting tribute from them at Constantinople. His capital at Preslav he beautified with ornate temples and palaces. Furthermore, Bulgaria was able to reap profit by serving as a middle-man in the trade between Asia and the countries of northern Europe, and engaged in commercial wars with Byzantium which finally led to military successes against the Emperor Romanus and the exaction of more tribute money.

**Subjection to Other Countries.** When Simeon the Great died, Bulgaria rapidly declined. The Magyars invaded and overran the country, and the Russians, invited by the Byzantine Emperor to help subdue the Bulgarians, threatened to occupy the entire country, but were prevented by the Emperor John Zimiskes. There was now no organized resistance in eastern Bulgaria, though the Tsar Shishman held out in the west. His fourth son, Samuel, 976-1014, and Basil II, known as Bulgaroktonos, the Bulgar-slayer, waged a long and disastrous war for the mastery of the Bulgarian territories in which the Byzantines finally defeated the Bulgars in 1014.

Bulgaria became a province of the Empire, and was ruled by a viceroy from Byzantium at Skoplje from 1018 until the latter part of the 12th century. Then the Bulgars revolted, regained part of their empire, and began another period of ascendancy. Asen II, 1218-43, ruled Bulgaria during the second golden age, which surpassed that of Simeon the Great. It was an age of progress, prosperity and public works, an age in which commerce, education and religion flourished. Like Simeon, Asen built a beautiful capital, Trnovo. When Asen died his empire split into several small states which gradually came under the influence of Serbia. In 1330 the Serbs defeated the Bulgars, killed the Tsar, and the next year under Stephen Dusan dominated most of Bulgaria. *See SERBIA: HISTORY OF.*

In 1366 the Turks, who had entered Europe about the middle of the 14th century, forced Tsar Shishman to do homage to them, and in 1393 took Tirnovo and control of the Bulgarian territories. From this time until the 19th century the Turks held the Bulgars in submission, changing their country's name from Bulgaria to the Province of Rumelia. The Bulgars were subjected to all the injustices of the conqueror toward the conquered, although the Turks were not so intolerant in religion or so despotic in government as they showed themselves elsewhere. The Christians had little chance for justice in the courts, and were considered morally inferior to their masters. No general conversion methods were attempted by the Turks;

moreover, the Bulgarian peasant life was allowed to remain substantially as it was.

But in the 17th century the situation of Turkey in Europe began to change. In 1699 the Turks were excluded from Hungary. Nearly a century later, in 1774, they recognized in the Treaty of Kuchuk-Kainarji the right of Russia to intervene in behalf of the Christian races within the Ottoman Empire. But in 1856 by the Treaty of Paris, ending the CRIMEAN WAR, Russia lost the right to interfere in the internal affairs of Turkey. In 1876 the massacre at Batak shocked all Europe, and Russia declared war on Turkey. The war lasted just one year, ending in the Treaty of San Stefano in Apr. 1878. This treaty provided that Bulgaria should be an autonomous principality of Turkey and that her boundaries should be the Danube, Okrida, the Aegean and the Black Sea. Thus Russia intended, probably for her own purposes, to satisfy the ambitions of Bulgaria. However, the other Powers of Europe feared the designs of Russia in the Balkan Peninsula and demanded a congress in which their interests would be represented. This met at Berlin and drew up a new treaty in July 1878. This document abrogated the Treaty of San Stefano, and destroyed its chief purpose, the creation of a Greater Bulgaria, by greatly decreasing the size of the proposed state and by placing it once more under the sovereignty of the Porte. *See TURKEY: HISTORY OF.*

**Under Sovereignty of the Porte.** On Feb. 1878 the Constituent Assembly had drawn up a very liberal constitution, so that a prince ruler was the one thing lacking. The assembly elected the Russian candidate, Alexander of Battenberg, a member of the House of Hesse and nephew of ALEXANDER II. Administering the affairs of state entirely to the advantage of Russia and without regard for Bulgarian nationalism, Alexander grew unpopular, especially with the Liberals led by STAMBULOFF. The prince, by dismissing the Tsankov Liberal Government, formed a Conservative one under a Russian minister, and had himself declared dictator for the period 1881-88. His uncle Alexander died in 1881, so that the prince began to work for Bulgarian nationalism. In 1885 the Liberals proclaimed the annexation of Eastern Rumelia, and were supported in their action by Great Britain. Serbia, frightened by this displacement of the balance of power, declared war in the same year, but was defeated and forced to sign the Treaty of Bucharest in Mar. 1886. This situation caused the opposition of Russia to Prince Alexander and his abdication in September. He appointed as regents Stambuloff, Karaveloff and Mutkoroff. Faced with the difficulty of choosing a prince approved by the Powers, the Bulgarians at last elected Ferdinand of Saxe-Coburg-Gotha, who took his official position in July 1887. As neither Russia nor the rest of Europe would recognize Ferdinand, Stambuloff acted as virtual dictator until 1895, when he was murdered through a Russo-Bulgarian plot. During his dictatorship he had magnified the public works, established banks, insured the public



safety, fostered education and rebuilt and modernized Sofia, the capital city.

**Independence Recognized.** From 1906 the policy of Bulgaria both at home and abroad revolved about the status of the Bulgars in Macedonia. Constant friction there with Turkey and the Balkan States and the strained situation caused by dependence on the Turks caused Ferdinand in 1908 to proclaim the principality a kingdom and himself King of all the Bulgarians, including those in Thrace and Macedonia. The independence of the Bulgars was recognized by the Powers in Apr. 1909. In the hope of freeing the Macedonian Bulgars, Ferdinand concluded an alliance with Greece and Serbia in Oct. 1912 against Turkey; the alliance, together with Montenegro, declared war on Turkey in the same month. This First Balkan War ended with the Treaty of London in May 1913, and resulted in the Independence of Albania and the surrender of all Turkish land in Europe north of the Enos-Media line. Disputes over the disposition of the spoil soon led to open hostilities and the Second Balkan War, beginning in June 1913, in which Bulgaria suffered a severe defeat. It ended in Aug. 1913 with the Treaty of Bucharest by which Bulgaria lost her lands in Thrace and Macedonia to Serbia and Greece, and southern Dobruja to Rumania.

Relations with the Entente having proved unsatisfactory in 1913-15, Bulgaria found it easy to cast her lot with the Central Powers, partly because of her pro-German ruler, Ferdinand. In 1915-18 Bulgarian forces occupied Serbia and the capital of Rumania, and regained Macedonia and southern Dobruja. However, the ravages of the war and the plausibility of the FOURTEEN POINTS brought an unconditional surrender to the Allies in Sept. 1918. Ferdinand abdicated the next month in favor of his son, Boris. By the Treaty of Neuilly, signed in Nov. 1919, Bulgaria lost her lands along the Aegean Sea and in southern Dobruja, and was assessed \$450,000,000 as a war indemnity. Under the leadership of STAMBOLISKI this was reduced at the LAUSANNE CONFERENCE in 1922-23 to \$110,000,000. He also attempted the formation of a communistic peasantry in close touch with Russia, and advocated the ascendancy of the poor over the bourgeoisie. He and his agrarian ministry fell by a *coup d'état* of the combined Nationalists and Macedonians in June 1923, and Stamboliski was killed.

Since 1924 the chief problems of Bulgaria have been the status of the minorities in Greece, Rumania and Yugoslavia, and the grave economic condition of the country. With the minority question Bulgaria has tried to cope by granting land to all refugees from Greece, Rumania and Yugoslavia, assisted by loans from the United States and Great Britain. Her financial recovery, however, has been hampered by the loss of her fertile lands on the Aegean and in Dobruja. Not only has she been unable to pay reparation claims, but also has been faced by a mounting national debt. The diplomatic relations of the several Balkan States have been considerably improved by the removal of

minority groups under the exchange of population plan.

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**BULGARIAN**, a South SLAVIC language spoken by about 3,500,000 persons in Bulgaria and by some 2,000,000 in Turkey, Rumania and the Yugoslav Banat. Originally Bulgar designated a Turkish tribe which invaded Moesia about 680, subdued the Slavs settled there, and later was absorbed by them. The numerous Bulgarian dialects may be divided into eastern and western groups, all of which have a post-fixed article and are less inflected than any other modern Slavic language. The earliest texts (10th and 11th centuries) are termed Old Bulgarian or Old Church Slavic; Middle Bulgarian extends from the 12th to the 14th century; and Modern Bulgarian begins with the latter date. The present literary language, mostly through borrowing from RUSSIAN, has been purged of the innumerable Turkish, Greek, Albanian and Rumanian (*see* separate articles on these languages) elements with which the colloquial speech is interspersed. The alphabet, except in the very oldest period, when Glagolitic characters were employed, is Cyrillic. A. SE.

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**BULGARIAN ATROCITIES.** Encouraged by widespread peasant revolts in Bosnia and Herzegovina in 1875, and by numerous manifestations of Serbian and Montenegrin unrest, a group of patriotic Bulgarian leaders in 1876 planned a general uprising of the Christian peoples within the Ottoman Empire. A majority of the leaders had their headquarters outside the sultan's realms, but effective systems of underground communication with the Bulgarian patriots at home had been established. The Turkish authorities soon became aware of the scheme and determined to strike before the movement could gain much headway. The conspiracy was poorly organized and not well coordinated, and the irregular Turkish militia, the Bashi-Bazuks, hailed with delight the commission to slaughter the infidels. In May, 1876, the soldiers fell upon and destroyed the Christian villages on the northern slope of the Rhodope Mountains, massacring at least 10,000 men, women and children. Europe was or professed to be horrified at these atrocities, and in the following year they were used by Tsar Alexander II as one of the pretexts for a declaration of war upon Turkey.

**BULKHEAD**, a wall or other structure at a waterfront built to keep back the earth; also the walls at inner ends of slips. *See also* QUAY WALLS; SEA WALLS.

**BULK MODULUS.** *See* ELASTICITY.

**BULL, OLE BORNEMAN** (1810-80), Norwegian violinist, was born at Bergen, Feb. 5, 1810. Although largely self-taught, he developed a marked degree of virtuosity, and toured successfully in Europe. He

made five trips to the United States between 1843 and 1879. He possessed a remarkable ability to sway his audiences emotionally. He died at Lysö, near Bergen, Aug. 17, 1880.

**BULL**, in the stock exchange, a person who believes that those elements affecting the price of commodities or stocks point to a rising market and who consequently buys with the expectation of making a profit. Bulls are market optimists as distinguished from BEARS. The bull trader views conditions as favorable and represents the long interest in the market. One may be a bull on a particular stock, and at the same time be a bear on another stock. Many successful traders are bulls at one time and bears at other periods.

**BULL, PAPAL.** This term is applied to various classes of "apostolic letters" issued by the Holy See; the name is derived from the Latin *bulla*, the leaden seal customarily affixed thereto. The earliest complete specimen extant is a bull of Paschal I, 819, but there is a fragment of a bull of Adrian I, 788. Other than that there was a reorganization of the papal archives and chancellery in the pontificate of Julius I, 337-352, when provision was made for the registration of letters, knowledge for the period preceding the pontificate of Adrian I, 772-795, is vague. From then on, "apostolic letters" are classified under two headings, Bulls and Briefs, though some authorities on diplomatics, e.g., Leopold Delisle, have preferred the terms Privileges and Letters. The term "brief" is self-explanatory: it means a letter shortened by the omission of elaborate formal phraseology. Seemingly there is no rule to determine which form shall be employed; thus the Society of Jesus was suppressed by a bull and restored by a brief. From Innocent III, 1198-1216, to the present there is an almost unbroken series of *Regesta*, registers of papal letters.

Modeled on the type of the ordinary Roman letter, papal bulls were first written on papyrus, and later on large sheets of thick parchment, with the *bulla* affixed; they opened with the name of the pope, ended with a dating clause, and contained, after the substance of the message, an imprecatory clause calling down divine vengeance on any who might impede or transgress what was set forth in the letter. The conservatism of the Curia was such that apostolic letters were written in an archaic hand; by the close of the Middle Ages it became necessary to send with each bull a copy, written in another hand and legible to the ordinary reader. To-day papal bulls are written in ordinary Roman script, and the sanctions are usually ecclesiastical punishments. Beginning with the pontificate of Leo XIII, the use of the *bulla* was largely discontinued, and in its stead the seal is usually stamped in red ink upon the letter.

A. H. S.

**BULLARD, ROBERT LEE** (1861- ), American army officer, was born at Youngsboro, Ala., Jan. 15, 1861. He graduated at West Point in 1885, serving in the U.S. Army. He was officer in the volunteer service, becoming colonel of 3rd Alabama Infantry,

Aug. 6, 1898, serving in Cuba with his regiment, and in the Philippines during the insurrection. He was made major in the U.S. Army (regulars) in 1901, becoming lieutenant-colonel in 1906, and colonel in 1911. In 1917, upon entry of the United States into the World War, he became successively brigadier-general, major-general and lieutenant-general in the National Army, and major-general in the regular army, Nov. 1918. He commanded the 2nd Brigade of the 1st Division (Dec. 1917 to July 1918), the 3rd Corps (from July to Oct. 1918) and the 2nd Army (from Nov. 1918 to Apr. 1919). At the second battle of the Marne, upon being commanded by the French to retreat, he refused, saying in his famous reply, "We are going to counter-attack." He received many foreign decorations and was awarded the United States Distinguished Service Medal. He retired from active service in 1925 and wrote *Personalities and Reminiscences of the War*.

**BULLET**, a projectile fired from SMALL ARMS, i.e., rifles, pistols and machine guns. The name originally denoted a small ball but has since come to include small projectiles of any shape. Modern small arms fire a cylindrical bullet tapered toward the front to minimize air resistance and flat at the rear to receive the propellant.

The U.S. Army has adopted a stream-line or boat-tail rifle bullet. The rear or tail is slightly tapered so as to reduce the vacuum in its wake during flight. The boat-tail cartridge has an effective range almost double that of the old cartridge due chiefly to the change in the shape of the bullet.

The First Hague Conference, 1899, banned the use of "bullets which expand or flatten easily in the human body, such as bullets with hard envelopes which do not entirely cover the core, or are pierced with incisions." These are generally known as dum-dum bullets from the fact that they were first manufactured at the British arsenal of Dum-Dum in India. In 1868 the so-called Declaration of St. Petersburg stipulated that no projectile of a weight less than 14 oz. might be explosive. The use of bare lead or soft nose bullets is confined to low powered fire arms on account of leading effect which increases with muzzle velocity. High powered rifle and pistol bullets require a jacket of hard metal enclosing the lead slug. The term steel jacket is a misnomer. The metal is an alloy of copper and nickel called cupronickel.

The tracer bullet developed during the World War for aircraft and antiaircraft machine gunnery contains in its base a mixture of barium peroxide and magnesium, which, when ignited by the powder charge emits a bright glow during the flight of the bullet.

E. D. P.

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**BULL-FIGHTING**, the pitting of men against bulls, is of unknown origin. A form of bull-baiting was practiced by the Greeks and Romans. The present-day bull-fighting was developed in Spain, where it is the national sport. Forbidden in most countries for

its cruelty, it is nevertheless popular in several Spanish-American countries. The spectacle is generally staged in a *plaza de toro*, or special arena. Animals are carefully reared for their part. The bull, maddened by hunger, is set free in the arena, where it is first confronted by six or more *picadores*. The latter are mounted pikemen, whose legs are covered with steel armour. When the bull charges a horse, sometimes disembowelling the animal, the *picador* drives his *garrocha*, or pike, into the bull's back. If the *picador* is dismounted, he is usually rescued from the horns of the bull by the *banderilleros*, or *matadors*, whose red cloaks serve to divert the animal. *Picadores* retire when a trumpet blows, which is the signal for the planting of the barbed darts by the *banderillero*. The latter incites the bull to charge and plants the dart in its neck, meanwhile adroitly dodging the horns of the infuriated animal. The third stage is the killing of the bull by the *espada*, armed with a sword. This *coup de grace* is a difficult stroke, aimed at the back of the neck to reach downward to the heart. Six bulls are customarily killed at one spectacle. In Spain about 1,300 bulls and about 6,000 horses are killed every year.

**BULLFINCH**, the common name for a genus (*Pyrrhula*) of small birds of the finch family found in the Old World. They have a thick head and neck, a short thick bill and very fluffy plumage. The common bullfinch (*P. europaea*), widely distributed in Europe and resident throughout its range, is about the size of a house sparrow. The male has black wings, head and tail, gray back and brick-red and white underparts, while the female has dull brown plumage. Moving about in pairs, the bullfinch frequents orchards and woodlands and feeds upon seeds, buds and berries. The cup-shaped nest, in which are laid 4 or 5 greenish-blue eggs, is placed in dense shrubs or hedges. Because of its charming song, a low musical piping, and its ability to learn bits of tunes, the bullfinch is a favorite cage bird in the Old World.

**BULLHEAD**, called also bullpout, and horned pout, the popular name of several fishes belonging to the catfish (*Siluridae*) and scaleless sculpin (*Cottidae*) families. In the United States they range from New England to Florida and west to the Great Lakes and North Dakota. They have been introduced into the rivers and lakes of California and Oregon, where they multiplied and are now in some demand as a food fish. The native bullheads prefer sluggish waters, where they swim about close to the bottom in search of smaller food fish. They have stocky bodies and large mouths, surrounded by long barbels, varying in color from yellowish-brown to black. Fishermen dislike bullpout because they swallow a hook after striking and it must be extricated with great care since the pectoral spines are sharp. The common bullhead (*Ameiurus nebulosus*) attains a length varying from 12 to 18 in.; the smaller, black bullhead (*A. melas*) grows from 6 to 10 in. in length. European bullheads are small, spinous fishes, plentiful in the lakes and rivers of the northern and central re-

gions. Miller's Thumb (*Cottus*) is a general name for them in England.

**BULLION**, gold or silver in bulk or in the form of bars, when its value is determined by the weight and fineness of its metal content alone. Bullion may therefore be objects of art, plate or coins, as long as they are so valued. Bars of gold or silver are the most common form of bullion. This form is extensively used in the settlement of international trade balances. In all cases, to establish its value, it must be weighed, assayed and valued by a recognized bullion broker or governmental assay officer.

**BULL KELP**, a gigantic seaweed (*Nereocystis Luetkeana*) found on the Pacific coast from California northward. It has very long cable-like stems, solid below and hollowed above into a huge bulb beyond which are borne the leaves. See also BLADDER KELP.

**BULL MOOSE PARTY**, a nickname for the PROGRESSIVE PARTY, current in 1912-13; so-called in allusion to its nominee for president, THEODORE ROOSEVELT, who remarked at the convention in 1912 that he felt like a "bull moose."

**BULL RUN, or MANASSAS, BATTLE OF**, July 21, 1861, the first important engagement of the CIVIL WAR. The Union forces in Virginia consisted of 35,000 men under McDowell, along the Potomac opposite Washington; 20,000 under Patterson in the Shenandoah valley, and 10,000 at Hampton Roads under Butler. The Confederate forces included Beauregard's army of 23,000 at Manassas Junction; 10,000 under Magruder near Hampton Roads; and 10,000 under J. E. Johnston in the Shenandoah valley. McDowell's plan of campaign was that he should attack Beauregard at Manassas while Butler detained Magruder and Patterson halted Johnston. Patterson stupidly retreated, allowing Johnston's force to join Beauregard's. McDowell, unaware of the Confederate reinforcement, attacked Beauregard on the morning of the 21st. Advancing across Bull Run creek and storming the plateau of Manassas, the Union forces forced the enemy back over 2,500 yards before a rally led by Gen. T. J. JACKSON, thereafter called Stonewall Jackson, halted the retreat. From noon until three the two armies fought desperately, with apparent assurances of a Union victory. The sudden arrival of the last contingent of Johnston's army, 2,000 men under Gen. E. K. Smith, shifted the advantage. The Federal troops, lacking sufficient training to meet the emergency, retreated in confusion; but the Confederates failed to follow up the victory by active pursuit. The casualties on each side approximated 2,000. The outcome was instrumental in persuading the Federal Congress to endorse and strengthen the leadership of Pres. Lincoln.

On Aug. 30, 1862, occurred the second Battle of Bull Run. In mid-August Gen. Lee's army (the corps of Generals Longstreet and Jackson) along the Rappahannock faced the Federal army under Major-Gen. John Pope, who was awaiting reinforcements from Gen. McClellan. Want of supplies forced the

Confederates to move, and Lee launched a daring plan of attack. After several days of complicated movements and counter-movements, Pope had been forced back several miles. The action of the afternoon of Aug. 30 began when Pope, mistakenly assuming Jackson's corps to be in retreat, ordered Gen. Porter to pursue and attack. Porter was repulsed. Then Lee's whole line, four miles long, made a general attack. The Union forces, not in proper alignment to meet the assault, never gained the advantage. The supreme struggle of the Union forces was to hold two elevated points, Bald Hill and Henry House Hill; their success in holding the latter hill permitted the Federal forces to cross Bull Run in orderly retreat. Gen. Lee did not pursue. At Centreville the Union army concentrated and received reinforcements, but, as Lee began an advance, the Union army was called to the defense of Washington by the alarmed civil authorities. The strength of the rival armies on Aug. 30 is estimated at 63,000 Federal troops and 54,000 Confederates; the casualties for the campaign (Aug. 16-Sept. 2) were about 8,500 Confederates, and, for the Union troops, 10,199 killed and wounded and 4,236 captured or missing.

**BULL SNAKE**, a popular name for a species (*Pituophis sayi*) of harmless snake found in the United States from the Mississippi to the Rockies, and also in Mexico and southwest Canada. It is the largest North American snake, sometimes being 9 ft. long and 6 in. around. Usually it is orange in color, with dark red-brown or black blotches, and has a dark yellow head, and yellow underparts. It eats rodents such as rabbits and rats, and bird's eggs, which it breaks in its throat. Two related species are sometimes known as bull snakes: the Pacific bull snake, or yellow gopher snake (*Pituophis catenifer*) of the west coast, and the **PINE SNAKE**.

**BÜLOW, BERNHARD, PRINCE VON** (1849-1929), German statesman, was born at Flottbeck, May 3, 1849. Educated for the law, he chose diplomacy as his career, and after filling various subordinate posts of increasing importance, was appointed ambassador to Italy in 1894. He had meanwhile married an Italian princess. In 1897 he was appointed German secretary of state for foreign affairs and in 1900 became chancellor of the German Empire. He remained in Germany until 1909, when he resigned as chancellor after disagreement over the budget. In 1914 he made a futile attempt to prevent Italy's joining Germany's enemies. Besides his *Deutsche Politik*, 1914, a defense of his policy, he wrote *Imperial Germany* and later dictated his *Memoirs* which have been published since his death. After living for 15 years in retirement, he died at Rome, Oct. 28, 1929.

**BÜLOW, HANS GUIDO, FREIHERR VON** (1830-94), German pianist and conductor, was born at Dresden, Jan. 8, 1830. In 1839 he was a pupil of Friedrich Wieck in piano instruction, and studied harmony in Dresden. He began his advocacy of **RICHARD WAGNER's** principles in 1849, and in spite of family opposition, devoted himself entirely to help-

ing Wagner, from whom he learned conducting. He studied the piano with Liszt, and in 1857 married his daughter, Cosima, who later left him to become the wife of Wagner. Thereafter von Bülow devoted himself to recitals and to his duties as conductor of the Saxe-Meiningen orchestra. He died at Cairo, Feb. 12, 1894.

**BULRUSH**, the name given in the United States to various rushlike plants. The great bulrush (*Scirpus lacustris*) grows abundantly in the margins of ponds and in slow streams widely throughout North America. The green, pithy, leafless stems, which attain a height of 10 ft., are used in making mats and chair bottoms. Other large forms are the river bulrush (*S. fluviatilis*), which grows 6 ft. high, and the California bulrush (*S. californicus*), which exceeds 8 feet. The common soft rush (*Juncus communis*) is also known as bulrush. In England the name bulrush is sometimes applied to the cattail. The bulrush of the Nile, mentioned in the Bible, was the papyrus.

**BULWARK**, the sides (including plating, stanchions and gunwale) of a vessel extending above a deck exposed to the weather. Its main purpose is to keep seas from washing over the deck, and consequently is usually built forward on the **FORECASTLE** deck, and also between the forecastle deck and midship house, and between the midship house and Poop. Bulwarks are fitted with freeing ports (hinged plates) that swing open, thus allowing water from the deck to run off, and have openings (*see* **CHOCKS**) through which lines are run to **BIRTS** for handling the ship.

**BULWER, WILLIAM HENRY LYTTON EARLE, LORD DALLING** (1801-72), English diplomat and author, was born at London on Feb. 13, 1801. He was educated at Harrow and Cambridge.

In 1826 his *Autumn in Greece* appeared. Although he was for a time in the army, he entered diplomatic work, his first assignment being to the embassy at Berlin. This was followed by connection with the embassies at Brussels and The Hague. In 1837 he was secretary of the embassy at Constantinople, and followed that work with service at Madrid. As minister to Washington he helped to draft the **CLAYTON-BULWER TREATY** in 1850. From 1852-65 he was successively envoy extraordinary to Tuscany, commissioner at Bucharest, and ambassador to Turkey. In 1871 he was knighted. Bulwer died at Naples on May 23, 1872. Besides his early works, he published *France, Social, Literary, and Political*, 1835-36; *Life of Byron*, 1835; *Historical Characters*, 1868-70; and, incomplete, *Life of Palmerston*, 1870-74.

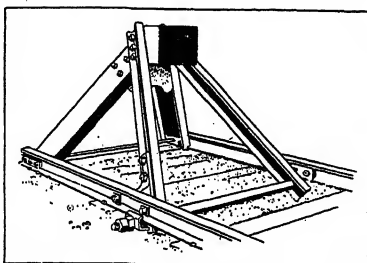
**BULWER-LYTTON, EDWARD GEORGE EARLE LYTTON**, 1st Baron. *See* **LYTTON, EDWARD GEORGE EARLE LYTTON, BULWER-LYTTON**.

**BUMBLE-BEE**, a popular name for many bees of the family *Bombidæ* (*Bremidæ*), native throughout the world, except in Australia and New Zealand. They are now common there, having been introduced to pollinate red clover blossoms which without their aid will set no seed. The life history differs from

that of the honey bee. In spring the young queens make nests in cavities, deserted mouse nests and other protected places. They then collect mixed masses of pollen and honey on which to lay the eggs. Only workers develop from these eggs. When these mature they do all the work except laying eggs. Late in the season drones and queens develop and mate but only the young queens survive the winter. In Great Britain they are called humble-bees because of their droning sounds.

**BUMBOAT.** See **BOAT**.

**BUMPER**, or **BUMPING POST**, devices to prevent railroad cars from running off the ends of stub



RAILROAD BUMPER

tracks. Large blocks of concrete, or steel posts often set in concrete, are commonly used, though frequently piles of dirt or old ties are used for this purpose.

**BUNAU-VARILLA, PHILIPPE** (1859- ), French engineer. He became director of the French Canal Company and negotiated the sale of this company's rights in Panama to the United States for \$40,000,000. He also played an important part in the Panama revolution, became first minister of Panama to the United States and negotiated the treaty leasing the Canal Zone to the United States, Nov. 18, 1903. Bunau-Varilla served in the World War. He devoted much of his energy to advocating a sea-level canal across Panama.

**BUNCHBERRY** (*Cornus canadensis*), called also dwarf cornel, a dainty almost herbaceous shrub of the dogwood family, native to low woods from Newfoundland to California and northward to Alaska. The short slender stem bears a whorl of ovate leaves and a solitary head of tiny greenish flowers. This head is surrounded by four white petal-like bracts, giving to the cluster the appearance of a single blossom about an inch across. The fruit is a compact bunch of vivid scarlet berries.

**BUNIN, IVAN ALEXEYEVICH** (1870- ), Russian poet and romance writer, was born in Voronezh, Oct. 10, 1870. His first volume of poems, published 1889, were awarded the Pushkin Prize. Bunin made a number of translations from English poets, including Byron's *Manfred* and *Cain*, Tennyson's *Lady Godiva*, and Longfellow's *Hiawatha*. He was elected to the Russian Academy in 1909. Bunin has also achieved high recognition for his classic prose. Among his works are *The Village*, *A Gentleman from San Francisco* and *Dreams of Chang and other*

*Stories*, all of which have been translated into English.

**BUNION**, a swelling of the big toe joint, due to irritation or inflammation of the bursa. A bunion manifests itself by a round swelling along the inner border of the joint. The big toe may or may not be forced outward. A bunion causes pain and discomfort and is usually tender to touch or pressure.

Bunions are due to irritation from short shoes, narrow shoes, and high-heeled shoes. Short stockings or those pulled too tightly predispose to bunions. Certain individuals have an hereditary predisposition to bunions. Bunion is uncommon in childhood, but common in adult life and especially in women.

The treatment of bunions consists in prophylactic and curative measures. Prophylactic measures include proper shoes which should be made over a straight last, have a round toe and a moderate height of heel. The stockings should not constrict the toes. Curative measures consist of rest, local application and in some cases, operation.

The term *hallux valgus* is often incorrectly used for bunion. *Hallux valgus* means a deviation outward of the big toe and is usually accompanied by enlargement of the bones which go to make up the big toe joint, especially the long bone on the inner border of the foot which is called the first metatarsal.

P. L.



BUNCHBERRY OR DWARF CORNEL  
Plant in flower and separate flower  
(enlarged)

**BUNKER HILL, BATTLE OF**, June 17, 1775, an engagement of the REVOLUTIONARY WAR which resulted in a British victory. Learning that Gen. Gage planned to secure the British occupancy of Boston by seizing two eminences overlooking the city, Bunker Hill and Dorchester Heights, the American troops, 16 miles away, decided to forestall him. Gen. Ward dispatched 1,200 men under Col. Prescott to occupy Bunker Hill; but Prescott, disregarding orders, occupied Breed's Hill, a lower elevation closer



to the city. Gage, contemptuous of the untrained militia, sent Gen. Howe with 3,000 troops to drive Prescott's men from the hill by a direct frontal attack. Two charges failed because of the Americans' deadly fire; then, their supply of powder failing, the Americans had no weapons to withstand the third assault but their gunstocks, and abandoned Breed's Hill. The British lost over 1,000 men, the Rebels less than 500. The name of the battle is a misnomer; it is properly the Battle of Breed's Hill.

**BUNKER HILL MONUMENT**, a granite obelisk 221 ft. high on Breed's Hill (now Bunker Hill) in the Charlestown district of Boston, erected to commemorate the battle of Bunker Hill. The corner stone was laid by the Marquis de Lafayette on June 17, 1825 and Daniel Webster was a spokesman. He was also the orator at the formal dedication in 1843 when the monument was completed. The completion of the monument was due to the activities of the women of Boston who organized a fair and raised \$30,000 to keep the work going. There is a flight of 294 stairs in the interior leading to the summit from which a fine view of the surrounding country may be obtained. At the base of the monument is a statue of Gen. Joseph Warren who fell in battle near the spot of the memorial.

**BUNKERS**, the space in a vessel where coal is carried. Their location depends on the type of vessel and the arrangement of machinery. In some, the bunkers extend fore and aft on both sides of the boiler room with the hull plating forming one side and longitudinal bulkheads the other, in which case they are called longitudinal or fore and aft bunkers, or they may extend across a vessel, with transverse bulkheads at each end, in which case they are known as transverse or cross bunkers.

**BUNNER, HENRY CUYLER** (1855-96), American humorist and novelist, was born at Oswego, N.Y., Aug. 3, 1855. He became a newspaperman and soon joined the staff of *Puck*, remaining with that humorous weekly until his death. Bunner contributed prose, verse, jokes, parodies, lyrics, brief stories, character-sketches and editorials. He was responsible, in 1884, for the famous cartoon of Blaine as the Tattooed Man. He also contributed to other magazines, and his first volume of poems, *Airs from Arcady and Elsewhere*, appeared in 1884. This was followed by *Rowen*, in 1892, and two volumes issued after his death as *The Poems of H. C. Bunner*, 1896. His works and stories include *The Midge*, 1886, *The Story of a New York House*, 1887, *Short Sixes*, 1890, *Zadoc Pine*, 1891, *The Runaway Browns*, 1892, *Made in France*, 1893, and *More Short Sixes*, 1894. Bunner died in New York City, May 11, 1896.

**BUNSEN, ROBERT WILHELM VON** (1811-99), German chemist, was born at Göttingen, Mar. 31, 1811. In his university work he specialized in the physical sciences and after teaching in several institutions in 1852 became professor of chemistry in the University of Heidelberg. Here he remained active as a teacher and a research man until within

a few months of his death, which occurred at Heidelberg Aug. 16, 1899.

In 1859 he worked out with G. R. KIRCHHOFF a method of spectrum analysis by means of which he was able to isolate the elements caesium and rubidium. But it is for the Bunsen Burner, with which his name is most commonly associated, that he is best known. By introducing a combination of air and gas at the same time, a smokeless non-luminous flame was produced that has become widely used for laboratory and domestic purposes. One of his early discoveries, which cost him the sight of one eye, was that of ferric oxide as an antidote for arsenic poisoning. Other discoveries and inventions to his credit are the ice calorimeter, the vapor calorimeter, and the filter pump. His most important book is *Chemische Analyse Gasometrischer Methoden*, 1857. In the field of organic chemistry his most important contribution is the significance of the radical in determining the nature of an organic compound.

**BUNSEN BURNER**, a device for burning gas to produce a hot, non-luminous flame, invented by BUNSEN about 1855. It mixes a suitable amount of air with the gas so that combustion takes place throughout the interior of the FLAME. The gas issues from a small opening at the base into a tube, usually about 1 cm. in diameter and 12 to 15 cm. high. Air enters through adjustable openings at the base of this tube and mixes with the gas before it reaches the flame at the top. The burner of an ordinary gas stove works on the same principle.

W. W. S.

**BUNTING**, the popular name for various birds of the finch family. Technically the true buntings are all members of the subfamily *Emberizmae*. Of the Old World buntings the best known are the corn bunting (*Emberiza miliaria*), the yellow bunting or yellow-hammer (*E. citrinella*) and the ortolan (*E. hortulana*). In North America the name is applied to several closely allied species as the indigo bunting (*Passerina cyanea*), a beautiful song bird common from the Great Plains eastward and southward; the painted bunting or nonpareil (*P. ciris*) of the southeastern states with brightly colored plumage variegated with indigo-blue, green and red, and the snow bunting or snowflake (*Plectrophenax nivalis*), with predominantly white plumage somewhat marked with black, breeding in the arctic zone as far north as 83° N. lat. and ranging southward in winter to the northern United States. Of these the snow bunting is the only true bunting. See also INDIGO BUNTING; ORTOLAN; SNOWFLAKE.

**BUNYAN, JOHN** (1628-88), English writer, was born at Elstow, near Bedford, probably Nov. 20, 1628, the son of a village tinker. He learned to read and write but had little further education. It was the period of the Civil War, and at 17 Bunyan became a soldier in the Parliamentary army. About 1649 he married a woman of a gentle and religious nature, and it is thought that he was persuaded by her to join the Baptist church at Bedford. Subsequently he was

appointed gospel minister of the church, and in this capacity he journeyed through the midland counties, preaching with the impassioned zeal characteristic of that Puritan age. In 1660 Bunyan was arrested near Bedford under the laws against non-conformity, and except for a brief respite in 1666, he was in prison till 1672, when the Declaration of Indulgence was issued by Charles II; after his release he was licensed to preach in Bedford, but was imprisoned again in 1675, when the Declaration was cancelled. He spent the rest of his life in preaching and writing, gaining fame in both fields. In the autobiographical *Grace Abounding*, published in 1666, Bunyan describes his career up to the time of his imprisonment, including also some of his prison experiences. He is revealed as a simple, energetic, devout man whose life was consecrated to serving the common people. Among his works of a later date are *The Life and Death of Mr. Badman*, *The Holy War* and numerous religious tracts. Much of his writing was done in prison, and before his release in 1672 Bunyan had begun his masterpiece, the *PILGRIM'S PROGRESS*. The first part of this celebrated allegory was published in 1678, the second part in 1685. Intended primarily for the lower classes, it became one of the most widely read books in English, and it has been translated into practically every language. Its theme is the old but eternally appealing one of a pilgrim, "Christian," who travels past innumerable hardships, trials and temptations along the arduous road to the New Jerusalem. Its language is that of the Bible, spontaneous, direct, graphic. Perhaps no other book in English literature has been read by so many people with so much pleasure and profit. Bunyan died at Snow Fields, London, Aug. 31, 1688.

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**BUOY**, a floating body moored at a certain place to indicate the position of something beneath the surface of the water. There are a variety of types, each being designed for a special purpose. Thus there are bell buoys, cylindrical or conical in shape, built of steel plates on which is mounted a bell that is hit by clappers, and spar buoys consisting of painted spars. Gas buoys mark important channels and are equipped with tanks containing compressed gas which is used for lighting purposes at night.

**BUOYANCY, CENTER OF**, of a vessel is the center of gravity of the displaced water and is determined by the underwater shape of the hull. The calculations for the vertical and fore and aft position of the center of buoyancy are made simultaneously with those for the **DISPLACEMENT** of the vessel. For ordinary freighters the vertical position is from .4 to .45 of the mean draft, and the fore and aft location is a little aft of the midship section. *See also* **NAVAL ARCHITECTURE**.

**BUR**, a prickly fruit or head of fruits, as that of the chestnut and burdock. Most commonly the term is applied to seed cases covered with hooked prickles that readily become attached to the hairy coats of

animals, thereby aiding in seed dispersal. Familiar examples are seen in the cocklebur and sandbur. Sometimes the word forms a characteristic part of the name of plants possessing such structures for the protection and distribution of their seeds, as bur-clover (*Medicago*) and bur-marigold (*Bidens*).

**BURBANK, LUTHER** (1849-1926), American experimental botanist. Receiving only a high school education he early began private botanical studies and at the age of 21 bought a small farm at Lunenburg, Mass., for experiments in plant breeding. In 1875 he moved to Santa Rosa, Calif. where he established his experimental farm and remained for the rest of his life. Burbank produced new and useful varieties of many plants, including potatoes, apples, peaches, quinces, cherries, berries, grains and many market vegetables and garden flowers. His development of spineless cacti suitable for cattle fodder is of importance in the arid lands of the west. Burbank was born at Lancaster, Mass., Mar. 7, 1849 and died at Santa Rosa, Calif., Oct. 11, 1926.

**BURBANK**, a city in Los Angeles Co., southern California, adjoining Los Angeles and Glendale; it is served by the Southern Pacific Railroad, Pacific Electric Railway and bus lines. Poultry and truck farming are the leading interests of the countryside. The city has motion picture studios, a chinaware factory, canneries, and factories turning out airplanes, motor trucks, soap and toilet articles, water heaters and woolen and knit goods. The retail trade in 1929 amounted to \$6,404,976. Oil and gas are piped in from the Bakersfield region. Burbank was founded in 1887 and incorporated in 1911. Pop. 1920, 2,913; 1930, 16,662.

**BURBOT** (*Lota maculosa*), the only fresh-water fish of the cod family (*Gadidae*), called also lake lawyer. It is found widely in lakes and slow streams in Europe, Asia, and North America, especially northward. In color the burbot is dark olive mottled with blackish. It has an elongate body, 1 to 3 ft. in length, two dorsal fins and a long barbel on the chin. Though its flesh is inferior in quality the burbot is sparingly used for food. *See also* **LING**.

**BURDETT-COUTTS, ANGELA GEORGINA**, (1814-1906), English philanthropist, was born at London, England, April 21, 1814. Upon inheriting her grandfather's estate, she added his name, Coutts, to her own. This inheritance enabled her to carry out a number of philanthropic projects. Among these were the founding of the Shoeblack Brigade, of public markets, and of the Society for the Prevention of Cruelty to Children. She built many churches and schools, and provided for many destitute boys. Many famous men, including Dickens and Faraday, were among her close friends. She was the first woman to receive the freedom of the City of London, was created a peeress by Queen Victoria in 1871, and was honored by burial in Westminster Abbey. She died at London, Dec. 30, 1906.

**BURDOCK** (*Arctium Lappa*), a coarse biennial plant of the composite family, native to the Old World

and widely introduced as a weed in the United States and Canada. It grows from 4 to 9 ft. high, bearing very large leaves, sometimes 18 in. long, and numerous purple flowers clustered in dense heads, which in fruit become large burs. In Japan the burdock is cultivated for its roots, young shoots and tender leaves, which are used in soups.

**BURE.** See **BURI**.

**BUREAUCRACY**, the type of administration in which the conduct of affairs is organized in offices of successively subordinate grade, each office in charge of a head with subordinate personnel. In the French Government, which is a type, public administration is distributed between "ministries" or departments, the head of each being a member of the "council of ministers." Each ministry is sub-divided into "directions, under directors," and these into appropriate "bureaus," under "chiefs." A comparable organization prevails under many governments, including the United States.

The defects of bureaucratic organization are its centralization of authority and discretion; the necessity it imposes of referring matters for recommendation and decision, with consequent delay; its tendency to develop elaborate rules and traditions; its attachment of the spirit of routine. It is these characteristics that attach an uncomplimentary sense to the words bureaucracy and bureaucratic. D. P. B.

**BUREAU OF PENSIONS.** See **PENSIONS**, **BUREAU OF**.

**BURGAS**, also **BOURGAS**, an important seaport of Bulgaria and capital of the district of Burgas; situated on the Gulf of Burgas between two lagoons and connected by direct railway with Stara-Zagora, the junction of the Philippopolis and Ruschuk lines. It has an excellent harbor, protected by lighthouses on nearby islands, with docking facilities for large vessels. Following the World War Burgas emerged as a serious competitor of **VARNA**, the country's chief Black Sea port, especially in the grain trade. The chief articles of trade are grain, wool, textiles, tobacco and dairy products. There are important sugar and soap factories and flour mills. Pop. 1931, 31,166. Bulgarians predominate; there are very few Greeks and Turks.

**BÜRGER, GOTTFRIED AUGUST** (1747-94), German ballad poet, was born in Molmerswende, Dec. 31, 1747. He studied theology at Halle and law at Göttingen. He wrote for *Musenalmanach*, the publication of the Göttingen Poetical Society, serving as its editor from 1778 until his death, June 8, 1794. He received an honorary degree in 1787 from the University of Göttingen and without remuneration, became assistant professor of philosophy and aesthetics. His greatest work was produced while he was still young. His popular ballads are classics familiar to every German schoolboy. *Lenore* and *Der wilde Jäger* were favorites among his ballads translated by Sir Walter Scott.

**BURGESS**, an inhabitant, citizen, or **FREEHOLDER** of a borough, usually one qualified to take part in its

government; also a borough representative in Parliament and in the lower houses of the legislatures of colonial Virginia and Maryland. The term is also used to describe a member of the borough governing board (Connecticut) or its president (Pennsylvania).

**BURGH, HUBERT DE** (? -1243), British statesman. In the Continental wars waged by King John he led a body of troops. In 1202 he was made castellan of Falaise. His loyalty to the king at the time the **MAGNA CARTA** was granted in 1215 resulted in his appointment as chief justiciar of England. The following year he succeeded in forcing the French to evacuate England. In 1219 he became leader of the English loyalists and an implacable enemy of Peter des Roches, Bishop of Winchester. After holding for 10 years the highest power in England, Hubert's enemies succeeded in causing his dismissal from office in 1232. He was charged with treason, but later pardoned. He died at London on May 12, 1243.

**BURGLAR ALARM**, a device, usually an electric bell, for attracting the attention of the police or of a watchman when someone is attempting to break into a building or to break open a vault or safe. As used to prevent secret entrance, the alarm usually comprises a bell connected to switches which are operated by the opening of a window or by someone's walking across the floor. Sometimes an arrangement is used which indicates which switch has been closed and, consequently, at what part of the building the entrance is being effected. These are often connected to the police station to give the alarm there. In commercial houses, especially banks, the safes and vaults are so connected to alarms as to notify the police when anyone tampers with them. These alarms are usually connected to push buttons within the reach of employees so that the alarm may be given in case of a daytime holdup.

**BURGLARY**, the breaking and entering of the dwelling of another in the night time with intent to commit a **FELONY** therein, whether the felony be actually committed or not. It was a felony at **COMMON LAW**. Various states have extended the definition in different ways or have created an offense of **LARCENY IN A BUILDING** to supplement it. Breaking means the use of force to gain entrance unlawfully.

**BURGLARY INSURANCE.** See **INSURANCE**.

**BURGOS**, a city of Spain, capital of Burgos province in Old Castile, situated in an amphitheater on a hill. Built in 900, it was the residence of the counts and kings of Old Castile. Burgos has a ruined citadel, old walls and gates, several squares and fine parks. The most noteworthy building is the great Gothic cathedral begun in 1221 and not completed until the 16th century. Besides other churches, there is the episcopal palace, the city hall and a triumphal arch. The city is the seat of a captain-general, a governor and an archbishop, and has a technological institute. Burgos is noted as being the birthplace of the Spanish national hero, the Cid. It has manufactures of wool and leather goods and trades in wool and cheese. Est. pop. 1929, 32,000.

**BURGOYNE, JOHN** (1722-92), English general, was born in Bedfordshire, England, on Feb. 24, 1722. He was educated at Westminster. Obtaining a commission in the army, he commanded the British troops in Portugal in 1762, and in the American Revolution he led the British army from Canada into New York state. He captured Ticonderoga on July 6, 1777, but was forced to surrender at Saratoga, Oct. 17, to Gen. Gates. When he returned to England, he was appointed commander-in-chief in Ireland. Soon after, he retired from military life and devoted himself to writing. He died at London on June 4, 1792.

**BURGUNDIAN**, originally an East GERMANIC language, long since extinct, the sparse remnants of which show admixture with West Germanic dialects, since the Burgundians, after leaving their northern home, spent several centuries migrating through central Germany. Finally, they established themselves on the Upper Rhine, with Worms as their capital, where they were almost annihilated by the Huns in 437, the survivors being led to Savoy and the surrounding country in 443, and there quickly merged in the Romance elements of the population. E. Ro.

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**BURGUNDIANS**, a Germanic tribe originally located in northern Germany east of the Oder river. In 286 A.D. they attacked the Rhine frontier, but were driven back by Maximian. Early in the fifth century the emperor Honorius was compelled to grant them territory in the upper Rhine valley, whence they gradually extended their holdings toward the south. In 437 they were defeated by the Roman general Aetius and settled in Savoy. By the end of the fifth century they occupied the Rhone valley. On the whole they remained faithful allies of Rome, fighting under Aetius against Attila in 451. The title of patrician was conferred upon their king Gundobad (473-516), who drew up a code of Burgundian law as well as an abridgement of Roman law for the use of his Roman subjects. The Burgundian kingdom was absorbed by the Franks in 534. See **BURGUNDY**.

**BURGUNDY**. Few place names have had such varying meanings as that of Burgundy. The original Kingdom of Burgundy, or more properly Kingdom of the Burgundians, was founded by a Germanic tribe of that name in the valleys of the Saône and Rhône during the 5th century. It was annexed to the Frankish kingdom in 534 but on the break-up of the Carolingian Empire it reappeared, though with its western boundary following the Saône. Its last king, Rudolph III, died in 1032, willing his kingdom to the Emperor Conrad II and thus incorporating it in the Holy Roman Empire. The northern part of this kingdom, between the Saône and the Jura mountains became the Free County of Burgundy (*Franche Comté*), while the lands west of the Saône, within the kingdom of France, became the Duchy of Burgundy. This duchy was created by the Carolingians,

annexed to the crown lands by Robert II, and in 1361 granted by John II to his younger son Philip. Meanwhile the former kingdom broke up into Dauphiny, Provence and Savoy, annexed by France in 1349, 1481 and 1860 respectively.

Duke Philip and his heirs gradually built up a powerful Burgundian state stretching to the North Sea; but on the death of the last Duke, Charles the Bold, in 1477 and the marriage of his heiress Mary to the Hapsburg Emperor Maximilian, France forced the surrender to the French Crown of the western fringes of Mary's inheritance, including the Duchy of Burgundy west of the Saône. The County of Burgundy remained a Habsburg possession, passing to the Spanish branch, but was annexed by France in 1678.

**BURI or BURE**, in Scandinavian mythology, the first man. At the creation of the world, he emerged from the rocks which were licked by the cow *Audhumla*, or Darkness. Buri was the father of Bor and the grandfather of ODIN.

**BURIAL RITES**, among primitive people, are based on the belief that the dead have entered into a new life. Some consider this new life to resemble the present one and therefore supply the dead with weapons, tools or food, which they may continue to bring to the tomb for some time after burial. These



FROM MAXIMILIAN VON WIED-NEUWIED'S ATLAS  
BURIAL RITES OF THE ASSINIBOIN INDIANS: A CORPSE DEPOSITED  
IN A TREE

From a drawing, by Karl Bodmer

same people may share another primitive idea that death renders any one, even the most loved relative, mysteriously dangerous. In this case the survivors practise rites to drive away the ghost; mourners and grave-diggers purify themselves and may even be secluded for a period lest the danger which threatens them should fall on the community. Other peoples

believe it is the departed himself who is in danger during the first stages of his new life, so they hold a feast to propitiate the spirits which might harm him.

**BURIN**, a steel tool used in line-engraving and marble-working. In form it is a long quadrangular prism, the cutting-end ground off obliquely to make a lozenge-shaped point, set into a short handle. For a line engraving the burin is pushed along in the direction of the desired line, and cuts out the copper cleanly. It is sometimes used to put finishing touches on an etching. The word burin is applied sometimes to the artistic style of the engraver, as a soft burin, a graphic burin, or a brilliant burin.

**BURKE, EDMUND** (1729-97), British statesman and writer, was born in Dublin, Ireland, probably on Jan. 12, 1729. He attended a private school at Ballitore in County Kildare in 1741-42, and in the next year went to Trinity College in Dublin, where he won no distinction for his scholarship, but studied zealously the orations of the Roman Cicero, his master. In 1750 he went to the Temple, but conceiving a deep distaste for the law, he turned to letters, and in 1756 published *A Vindication of Natural Society*, a satire on Bolingbroke. In 1759 he met William Hamilton whom he accompanied to Ireland. There he began to see the evils of the British régime and to conceive the reforms for which he fought in later days. In 1765 Burke broke with Hamilton, and became private secretary to Rockingham, the prime minister. He entered parliament for Wendover in 1766 and until 1790 was its undeniable leader. In 1783 he drafted the India Bill as part of the program of economic reform which he intended. During the next six years he carried on the most difficult project of his life, the impeachment of Warren Hastings, during which he delivered several of his most famous speeches, particularly the one on the debts of the nabob of Arcot. Although Hastings was acquitted of the charges against him in 1795, Burke revealed to the British nation the rational and just attitude necessary toward India. In 1790 appeared *Reflections on the Revolution in France*, a book which electrified Europe, and was enormously popular. In his opposition to the French Revolution he angered the Whig leaders, and was forced to leave the party in 1791. In 1794 his only son died, making Burke decline the title of Lord Beaconsfield which the king intended for him. However, he was awarded a pension of £2,500 by parliament. In 1796, upon hearing of the proposed peace with France, Burke published the first of the *Letters on a Regicide Peace*. Before the publication of the third of the series, Burke died on July 8, 1797.

**BURLEIGH, HENRY THACKER** (1866- ), American Negro singer and composer, was born at Erie, Pa., Dec. 2, 1866. In 1892 he won a scholarship at the New York National Conservatory, where he subsequently taught. He sang in various churches, and made long and successful tours in the United States and Europe. His songs and arrangements of "spirituals," among them "Deep River," display marked originality.

**BURLINGAME, ANSON** (1820-70), American diplomat, was born at New Berlin, New York, in 1820. He was graduated from the University of Michigan, 1841, and the Harvard Law School, 1846, and practiced law in Boston. Elected to Congress first by the Know-Nothing party in 1854, he was elected afterward by the new Republican party, and held his seat until 1861, when he was sent to China as Minister. In 1867 the Chinese honored him by sending him as a special envoy to the United States and to some of the important European powers. He succeeded in arranging the "Burlingame Treaty" in 1868, between China and the United States. Later on through his good offices China agreed to treaties with Great Britain, Prussia, Denmark, Holland and Sweden. Having gone to St. Petersburg to arrange a treaty with Russia, he died there, Feb. 23, 1870.

**BURLINGAME**, a residential suburb, 15 mi. south of San Francisco, Cal., in San Mateo Co., situated on San Francisco Bay, served by the Southern Pacific Railroad. The rapidly growing city is most attractive, with fine homes and beautiful surroundings. It contains several moving picture studios. The retail business in 1929 amounted to \$7,920,793. Burlingame was founded by the Spaniards, and was named in 1868 for Anson Burlingame. The city was incorporated in 1908. Pop. 1920, 4,107; 1930, 13,270.

**BURLINGAME TREATY**, 1868, an agreement between China and the United States, notable as marking the first acceptance by China of the principles of international law. It also provided that the emperor acknowledge the right of his subjects to voluntary emigration, while the United States conceded the right of the Chinese to become permanent residents of this country. Anson Burlingame, who represented China in the negotiations with Secretary of State WILLIAM H. SEWARD, was an American who, as Minister to China, 1861-67, had so completely gained the confidence of the Chinese Government that he was appointed as its envoy to the United States and various European nations.

**BURLINGTON**, a city in southeastern Iowa, the county seat of Des Moines Co., situated on the Mississippi, about 170 mi. southeast of Des Moines. Three railroads, bus lines, river craft, an electric railway and an airport serve the city. The countryside produces grain and live stock. Repair shops and factories producing soap, candy, baskets, caskets, furniture and Corliss engines form the principal industrial establishments. In 1929 the value of the factory output was about \$14,000,000; the retail trade amounted to \$16,212,488. Flint Hills State Park is immediately north. Zebulon Pike, explorer of Pike's Peak, instigated the establishment of a trading post here in 1829. The first settlers came in 1833. The town, then called Flint Hills, was later named after Burlington, Vt. It became a chartered city, and the capital of Wisconsin territory in 1838. Pop. 1920, 24,057; 1930, 26,755.

**BURLINGTON**, a city and port of entry of Burlington Co., N.J., situated on the Delaware River and



the Pennsylvania Railroad, 18 mi. southwest of Trenton. While mainly a residential city and agricultural trading center, it has a number of industrial establishments, including foundries and silk mills. The retail trade in 1929 amounted to \$4,944,708. It is the seat of St. Mary's Hall, a church school for girls founded in 1837. The city was settled in 1677 and originally called New Beverley and later Bridlington. For a number of years Burlington served as the capital of New Jersey both under the colonial and state governments. It has numerous places of historic interest including the birthplace of James Fenimore Cooper and a residence of U. S. Grant. The Burlington Library still operates under a charter granted by King George II. Burlington was incorporated as a town in 1693, reincorporated in 1773, and received its charter as a city in 1784. Pop. 1920, 9,049; 1930, 10,844.

**BURLINGTON**, a city in Alamance Co., in northern North Carolina, situated about 20 mi. east of Greensboro. An airport, bus lines and the Southern Railroad serve the city. Tobacco, wheat and corn are the chief crops of the district; while furniture and hosiery are the two important manufactures. The city was founded in 1845 and incorporated in 1887. The Battle of Alamance was fought 9 mi. from Burlington in 1771. Near by is Elon College. Pop. 1920, 5,952; 1930, 9,737.

**BURLINGTON**, port and largest city of Vermont, county seat of Chittenden Co., on Lake Champlain, about 40 mi. northwest of Montpelier. It is served by the Central Vermont and Rutland railways, lake steamers, motor buses and an airport. A trading and tourist center, this Green Mountain country offers winter sports and summer attractions, educational advantages and historical associations. Manufactures include lumber products, dyes and colorings, ovens, window-shade rollers, maple-sugar utensils, cotton and woolen goods, candies, overalls and refrigerators. In 1929 the value of the factory output was about \$12,000,000; the retail trade reached a total of \$18,048,530. Burlington harbor traffic in 1929 amounted to 19,691 tons, valued at \$5,457,415. The University of Vermont and State Agricultural College and Trinity College for girls are in Burlington. Near by is Fort Ethan Allen. Notable persons associated with the city are IRA and ETHAN ALLEN, patriots, EDWARD EVERETT HALE, writer, Senator G. F. Edmunds, and Admiral H. T. Mayo; Mrs. Calvin Coolidge was born here. Burlington was chartered in 1763, settled 11 years later and incorporated in 1865. Pop. 1920, 22,779; 1930, 24,789; 13½% were foreign-born.

**BURMA**, a territory comprising the largest province in British India; area 262,732 sq. mi.; extending from Tibet in the north to the Malay Peninsula in the south. In the northeast it is bounded by China, in the east by French Indo-China and Siam, and in the southwest by the Bay of Bengal. From north to south through the middle of the province runs the great River Irawada, which is navigable from its mouth at the Bay of Bengal to the city of Bhamo, a distance of 900 mi. The surface of Burma

is generally mountainous and covered with immense forests. The highest mountains are the Patkoi Hills in the northwest. They reach to heights from 12,000 to 19,000 ft. There are, also, extensive valleys and plains which are very productive. The chief agricultural products are rice, wheat, corn, tobacco, cotton and sugar cane. Lumber, tea and sesame are also produced in considerable quantities. The province abounds in minerals, especially iron, copper, tin and lead. Gold, silver and tungsten are also mined, and in 1927 Burma produced nearly 250,000,000 gals. of petroleum. Oil refining is the leading industry. The refineries are located at Syriam, not far from the capital. Textile fabrics are still produced in fairly large quantities, though cheap European goods have proved a blow to this industry. In all of Burma there are about a thousand factories and shops of all kinds with one hundred thousand employees engaged in them. The trade of Burma is mainly with India and with other parts of the British Empire. The principal exports are rice, timber, hides and skins, rubber, cotton and silk draperies. The imports include machinery, sugar, coal and hardware.

Rangoon and Mandalay are the largest cities. The bulk of the population belongs to the Buddhist religion. Other important religious groups are the Animists, the Hindus, the Mohammedans and the Christians. Of the latter there are about a quarter million. Pop. 1921, 13,212,192; 1931, 14,665,618.

**History.** The ascertainable facts of early Burmese life are few, and little of a social and political nature is known of the country prior to the 11th century. The first king of recorded history was Anawrahta, who in 1054 established the Pagan dynasty. He introduced Buddhism, and his family endured as rulers of Burma until 1287. A period of confusion, marked by the successive rise to power of Talaings, Shans and Burmans, lasted until 1531, when the house of Toun-goo formed a second Burmese empire. This dynasty prevailed until the Talaings of Pegu (lower Burma) put their own king in office in 1740. But another Burmese leader was found in Alangpaya, who in 1752-60 completely recovered all the country and invaded Siam. His successors were hostile to British envoys and missions sent from India, and in 1824 the British viceroy of India landed troops at Rangoon, with the result that in 1826 Arakan and Tenasserim came under British control.

The cruelties of such rulers as Bagyidaw and Tharawadi to their Talaing and other enemies led to a second British intervention in 1852, culminating in British annexation of the province of Pegu. A decade later the British territories became the province of British Burma. The last of the Burmese kings was Thebaw, who defied Sir Henry Prendergast in 1885, and was in consequence deported to India. The era of British rule throughout Burma began on Jan. 1, 1886. Colonial officers have since encountered in Burma all the difficulties of the British Government in India, contending with tribal revolts, boycotts and other obstacles raised by the Nationalist groups op-

posed to the pacification of their nation. An attempted boycott of the Prince of Wales, who visited the country in 1922, failed to materialize. In 1923 Burma was given provincial status in the Government of India. The rise of Nationalist feeling in India was reflected in a similar movement in Burma, with a demand for a larger measure of home rule. In the autumn of 1931 a new revolt broke out against British rule.

**BUR MARIGOLD**, the common name for a numerous genus (*Bidens*) of annual and perennial herbs of the composite family many of which are known as beggar-ticks, stick-tights or tickseed. There are about 90 species, widely distributed throughout the world, of which some 30 occur in North America. They grow usually 1 or 2 ft. high with opposite, toothed, deeply cut or often divided leaves, solitary or clustered flower-heads, with bright yellow or white rays or sometimes rayless, and numerous flat or angled seeds (achenes) armed with 2 to 4, usually backwardly barbed awns. Many are widely diffused as weeds.

**BURMESE**, a member of the Tibeto-Burman group of the SINO-TIBETAN linguistic family, subdivided into a large number of little-known dialects. While it resembles the other members of its group in possessing no INFLECTION, its pronouns of the first and second persons vary according to their use as subject or object, this corresponding to a phenomenon observed in ancient CHINESE, and perhaps explicable as a remnant of inflection. The alphabet is borrowed from India.

**BIBLIOGRAPHY**.—H. Bridges, *Burmese Manual*, 1915.

**BURNABY**, a city of British Columbia, Canada, situated in the eastern section of the city of VANCOUVER of which it is a residential suburb. Well-planned and substantially built, Burnaby shares in the industrial interests of Vancouver and is a thriving municipality. Pop. 1921, 21,710; 1931, 25,564.

**BURNE-JONES, SIR EDWARD** (1833-98), English Pre-Raphaelite artist, was born in Birmingham, England, Aug. 28, 1833. His association with William Morris began at Exeter College, Cambridge, where Burne-Jones was being educated for the church. Abandoning Oxford in 1856, the two became disciples of Dante Gabriel Rossetti, the leader of PRE-RAPHAELITISM. The aesthetic ideals of Burne-Jones as expressed not only in painting but in designs for stained glass, tapestries, metal-work and mosaics exercised a powerful influence on late 19th century art. His work is always highly decorative though somewhat mannered, and his figures have a distinctive quality, being slightly elongated, while the faces have a wistful expression. Among his well-known paintings are *The Mirror of Venus*, *The Golden Stairs*, *King Cophetua and the Beggar Maid*, *The Annunciation*, and *The Star of Bethlehem*. The artist was knighted in 1894, and died in London, June 17, 1898.

**BURNET** (*Sanguisorba minor*), a perennial herb of the rose family native to the Old World and naturalized locally in North America. It grows about a foot high, bearing divided leaves and numerous greenish flowers crowded in a head at the summit of

a leafless stalk. Burnet is sparingly cultivated as a salad plant.

**BURNETT, EDGAR ALBERT** (1865- ), American educator, was born in Hartland, Mich., Oct. 17, 1865. He took his B.S. in 1887 and his D.Sc. in 1917 at Michigan State Agricultural College, where he was an assistant from 1889-93. Burnett was professor of animal husbandry at the University of Nebraska, 1899-1907; associate dean in charge of agricultural instruction, 1901-09; and dean of the Agricultural College 1909-28. In 1908 he became chancellor of the University of Nebraska. Burnett directed the Nebraska Agricultural Experimenting Station from 1901-28. He was a member of the American Education Corps, with the first army, American Expeditionary Forces, in Beaune, France.

**BURNETT, FRANCES HODGSON** (1849-1924), Anglo-American novelist, was born at Manchester, England, Nov. 24, 1849. She came to America in 1865, living for some years near Knoxville, Tenn. At 17 she was writing stories. *That Lass o' Lowrie's*, 1876-77, brought her quick recognition, and *Little Lord Fauntleroy* made her famous. Other books about children were *Sara Crewe*, *Little Saint Elizabeth* and *The Secret Garden*. Mrs. Burnett wrote about 40 novels; of these *The Shuttle*, *The Pretty Sister of José* and *T. Tembarom* are among the most popular. She dramatized *Little Lord Fauntleroy* and *Sara Crewe*. Other plays, especially *Esmeralda* and *A Lady of Quality*, met with success. She died at Plandome, N.Y., Oct. 29, 1924.

**BURNEY, CHARLES** (1726-1814), English musicographer, was born at Shrewsbury, Apr. 7, 1726. He played the organ in London churches, composed incidental music for several plays, received his degree Mus. Doc. from Oxford in 1769, and was elected an F.R.S. in 1773. His major compositions include six sonatas for two violins and bass, incidental music for *Queen Mab* and *Robin Hood*, produced at Drury Lane, London, and six violin concertos. Burney's fame rests chiefly upon a four-volume work, *A General History of Music*, written during 1776-89. He died at London, Apr. 12, 1814.

**BURNEY, FANNY** (1752-1840), English novelist also known as Madame d'Arblay, was born at King's Lynn, Norfolk, June 13, 1752. As a girl she met many famous men, including Garrick, Burke and Dr. Johnson. Her first novel, *Evelina*, was published anonymously in 1778 and attracted much attention. Her other works of fiction, *Cecilia* and *Camilla: or a Picture of Youth*, were not so successful. Her fame rests upon her *Diary and Letters* in which many well-known persons appear. This work especially immortalizes her friendship with Dr. Johnson. She died at London, Jan. 6, 1840.

**BURNHAM, DANIEL HUDSON** (1846-1912), American architect, was born in Henderson Co., N.Y., Sept. 4, 1846. He studied architecture under private instructors at Waltham, Mass., and Chicago, Ill., where he won international reputation for his work as architect of the World's Fair (1893). There-

after he was constantly employed in city-planning for various municipalities, including Chicago, Washington, D.C., San Francisco, Cleveland, and Baltimore. In 1905 he was commissioned by the Government to draw plans for various cities in the Philippines, including Manila. Notable among his works are the Flatiron Building, New York City, the Railway Exchange, Chicago, the Pennsylvania Station, Pittsburgh, the Union Station, Washington, and Selfridge's, London. Burnham had an important influence on skyscraper architecture in the United States, where his successors developed many of his basic ideas. He died at Heidelberg, Germany, June 1, 1912.

**BURNING BUSH**, the name given to various plants with flame-red flowers or fruits, as the wahoo (*Euonymus atropurpureus*), and the strawberry bush



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

WESTERN BURNING BUSH  
(*Euonymus occidentalis*). Flowering  
branchlet and single flower

(*E. americanus*), both native North American shrubs. The dittany and the artillery plant are sometimes called burning bush.

**BURNING OF THE BOOKS**, the destruction in 213 B.C. of the Chinese classics, particularly those of Confucianism, during the reign of Ch'in Shih Huang Ti. This emperor had established a new dynasty and embarked on a program of political and social reconstruction. He wanted to make a new start throughout, and felt that the people were much too slavishly bound down by traditions from the already-ancient past. The actual order for the burning of the classics was given by the emperor's prime minister, but condemnation for this act has been visited on the emperor by Chinese scholars through the centuries.

**BURNLEY**, a town of Lancashire, England, about 22 mi. north of Manchester, situated at the base of Boulsworth Hill, which here rises to a height of 1,700 ft. from the River Brun, near its confluence with the Calder. The town, modern in appearance, has thrived in recent years. There is an ancient church, restored in 1867. The town hall is a fine building, and the educational establishments are splendidly equipped. Large cotton mills, several foundries, machine shops and collieries are situated in the neighborhood. Roman remains have been discovered in the town. Pop. (of county borough) 1921, 103,186; 1931, 98,259.

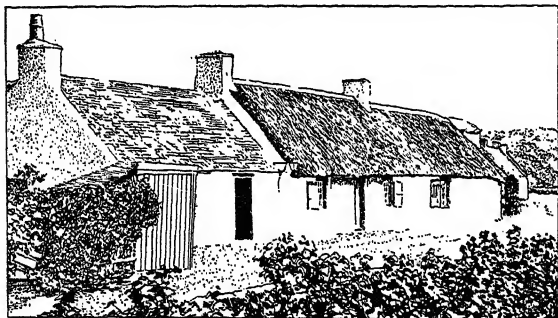
**BURNS, JOHN** (1858- ), English labor representative, was born at Vauxhall, London, on Oct.

20, 1858. After a rudimentary education in the common school at Battersea, he was employed in factories and engineering works, and completed his education in night schools and by reading. Through the influence of a French fellow workman Burns joined the socialists, and, after several months' travel and study on the continent, became an influential labor agitator in London. Entering upon a political career, he represented Battersea in the House of Commons from 1892 to 1914. Although sitting as an Independent Radical, Burns held the office of president of the Local Government Board in the cabinets of Campbell-Bannerman and Asquith, but left the government in Aug. 1914 upon the declaration of war. His writings include: *Municipal Socialism*, *Labor And Free Trade*, and numerous pamphlets, articles and speeches.

**BURNS, ROBERT** (1759-96), Scottish poet, was born in Alloway, Ayrshire, Jan. 25, 1759. His father, William Burness or Burns, was a small farmer, an upright and intelligent man; his mother, a farmer's daughter, could neither read nor write. Robert attended the school at Alloway Mill, had some instruction also from a young teacher named Murdoch and from his father, but gained most of his book knowledge from such volumes as he could borrow from friends or neighbors. Two influential books in his life were the *History of Sir William Wallace*, which roused his feeling for Scotland, and a collection of English songs, *The Lark*. The poet was doomed to a life of poverty, and at 15 he was doing a man's work on the farm. When he was 17 the family moved to Lochlea, in the parish of Tarbolton. Here Burns wrote many verses, singing them as he plowed or sowed or reaped; here he courted many a local beauty; and here his father died in 1784. The family moved next to Mossgiel, in the parish of Mauchline, and for a time Robert and his brother Gilbert attempted scientific farming. At Mossgiel the poet fell in love with Jean Armour, later to be his wife, and also with Mary Campbell, whose untimely death filled him with despair. He planned now to go to Jamaica, and to obtain the passage money for this venture published his first volume of poems, at Kilmarnock in 1786. The poems appeared and delighted Scotch men and women of every rank and condition. The new poet was invited to Edinburgh and spent there the winter of 1786 and the spring of 1787, being fêted by the most prominent men of the city. In 1787 he issued an enlarged edition of the *Poems* at Edinburgh. Burns returned for a time to Mossgiel, where he found Jean Armour the mother of twins by himself. He married Jean in 1788, and from that year till 1791 worked as a farmer and excise man at Ellisland, Dumfriesshire. In the winter of 1791, worn out by his labors, poor, discouraged and feeling himself an old man, Burns abandoned his farm and moved into Dumfries. In distressing poverty he died in Dumfries, July 23, 1796, and was buried there.

Robert Burns is easily the greatest of Scottish poets and one of the best loved of all poets. He had true

genius, and the goodness and honesty of his heart were not sullied by the tragic poverty and the many errors which beset his life. He knew well the people, the country, the old Scotch legends, and he sang of these things with all the warmth of his simple, sincere nature. For sheer music his lyrics have hardly been



ROBERT BURNS'S COTTAGE AT DUMFRIES, SCOTLAND

surpassed in any language. He was Scotch to the marrow of his bones, and, though he wrote many poems in English, he was most successful when pouring out his feeling for his own country and his own people in his own language. Among Burns's best known poems, many of which have been set to music, are "To A Mouse," "Hallowe'en," "Man Was Made To Mourn," "Highland Mary," "John Anderson, My Jo," "Scotch Drink," "Epistle to Davie," "Jean," "Mary Morison," "My Bonnie Mary," "A Red, Red Rose," "The Jolly Beggars," "To A Mountain Daisy," "Address to the Deil," "The Banks O' Doon," "Auld Lang Syne," *TAM O' SHANTER* and *THE COTTER'S SATURDAY NIGHT*. See also *ENGLISH LITERATURE*.

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**BURNS AND SCALDS.** A burn is the destruction of body tissue due to the application of dry heat or due to caustic agents. A scald is produced by hot liquids or steam. The surface area of a scald is usually much more extensive than that of a burn, but on the other hand the injury is much more superficial. However, even scalds produce scars.

The dead or gangrenous tissue caused by the burn or scald eventually separates itself from the body. Healing then takes place by the formation of scar tissue and new skin.

These injuries are usually classified, according to the extent of destruction, into three degrees. A first degree burn consists of simple surface scorching with redness of the skin. Recovery is rapid. In a second degree injury, the cuticle becomes detached and raised into blebs or blisters. Healing is usually without scar formation. Scalds are usually confined to first and second-degree injuries.

Third-degree burns include all more extensive injury than given above.

In addition to the local symptoms of pain and redness, burns of second and third degree may cause

general symptoms due to absorption by the body of substances created by the burn. Infection of the burned tissue may likewise occur. The general symptoms consist of fever, prostration, rapid breathing and restlessness.

In first degree burns the application of cold compresses to relieve the pain, followed later by a bandage, is satisfactory treatment.

When the burn is more severe and there is blistering, some oily preparation should be used. Olive oil or petrolatum serve this purpose.

The most disastrous local complication of a burn is added septic infection. The treatment of third degree burns is aimed toward the prevention and clearing up of such infection. If the wound is not infected, the surface may be cleaned with salt solution and then covered with picric acid, tannic acid or similar substances. More recently, covering the wound with a layer of specially prepared paraffin has been advised. When a burn has become infected, these methods are not suitable. Instead large wet dressings of boric acid solution or aluminum acetate may be used.

During healing, permanent deformity of joints should be prevented by the use of splints and movements of the joints. During this stage, skin grafts are also employed when found necessary to cover denuded areas. W. I. F.

**BURNSIDE, AMBROSE EVERETT** (1824-81), American soldier, was born at Liberty, Ind., May 23, 1824. He served an apprenticeship to a tailor, but graduated from West Point in 1847. He entered the Union Army as colonel of volunteers in 1861, commanded a brigade at Bull Run and in Feb. 1862, captured Roanoke Island. After important services at South Mountain and Antietam, he superseded McClellan in command of the Army of the Potomac, Nov. 1862. He was defeated by Lee near Fredericksburg, was successful at Knoxville, and in 1864 served under Grant through the battles of the Wilderness and Cold Harbor. After the war he was Governor of Rhode Island, 1866-68, and was elected to the United States Senate in 1875. He died at Bristol, R.I., Sept. 13, 1881.

**BUROW'S SOLUTION.** See *ALUMINUM ACETATE, NORMAL*.

**BURR, AARON** (1756-1836), American soldier and statesman, was born at Newark, N.J., Feb. 6, 1756. His father was President of Princeton College, at that time known as the College of New Jersey, and his mother was the daughter of the famous theologian, JONATHAN EDWARDS. Graduating from Princeton in 1772, Burr distinguished himself as a Revolutionary soldier. In 1783, married and having been admitted to the bar, he settled in New York, where he soon became prominent. A state senator in 1784 and attorney-general of New York in 1789, he became United States senator in 1791, defeating the father-in-law of Alexander Hamilton. In 1800 he was elected Vice-President of the United States, after a technical confusion of electoral votes which,

but for the opposition of ALEXANDER HAMILTON, might have made him President instead of THOMAS JEFFERSON, and which injured his political fortunes by arousing suspicion of his loyalty to Jefferson. In 1804 Burr was candidate for Governor of New York, and so resented an innuendo of Hamilton's against him that he challenged the famous Federalist to a duel in which, on July 11, at Weehawken, N.J., Hamilton was killed. This tragedy ended Burr's political career. When he appeared in 1806 as proprietor of a large tract of southwestern land from which he apparently hoped to invade Mexico, Jefferson believed that he was planning injury to his country; he was three times arrested, and on Mar. 30, 1807, placed on trial. Though acquitted, he had lost public confidence. He went to Europe, returning in 1812 to practice law in New York. In 1833 he married Eliza Jumel from whom he was later separated. He died at Port Richmond, Staten Island, Sept. 14, 1836.

**BIBLIOGRAPHY.**—W. H. Sampson, *The Private Journal of Aaron Burr*; also S. H. Wandell, and M. Minnigerode, *Aaron Burr*.

**BURRILLVILLE**, a town of northwestern Rhode Island, about 23 mi. northwest of Providence, on the New York, New Haven, and Hartford Railroad. Burrillville comprises the villages of Pascoag, Bridgeton, Harrisville, Oakland, Mapleville, Glendale, Nasonville and Tarkiln. The state tubercular sanatorium is on Wallum Lake, about 3 mi. northwest of Pascoag. Burrillville has manufactures of woolen and worsted goods. Pop. 1920, 8,606; 1930, 7,677.

**BURRO FAT** (*Isomeris arborea*), called also bladder-pod, a smooth low shrub of the caper family, found in southern California. It grows about 4 ft. high, bearing large yellow flowers and conspicuous, much inflated pods, containing bitter, pealike seeds. The bruised foliage exhales a strong, unpleasant odor. When in flower its bright blossoms add a characteristic note to the coast vegetation.

**BURROUGHS, JOHN** (1837-1921), American naturalist. He attended local schools, taught in Ulster County, N.Y., and later studied at the Ashland Collegiate Institute, and Cooperstown Seminary. EMERSON was his first literary master, but WHITMAN had an even more enduring influence. While in the Treasury Department at Washington, where he worked from 1863-73, Burroughs met Whitman, and *Notes on Walt Whitman, as Poet and Person*, was the naturalist's first published book. Later he wrote *Walt Whitman, a Study*, published in 1896. After leaving Washington, Burroughs purchased a farm at Esopus, N.Y., and there built his cabin, "Slabsides." He was an accurate observer, and his paper, *Real and Sham Natural History*, published in the Atlantic Monthly, 1903, provoked wide discussion. His most distinctive work was in the realm of the nature essay, and among his best-known books are, *Wake-Robin*, *Birds and Poets*, and *Locusts and Wild Honey*. Burroughs was born at Roxbury, N.Y., April 3, 1837 and died on his way home from California, Mar. 29, 1921.

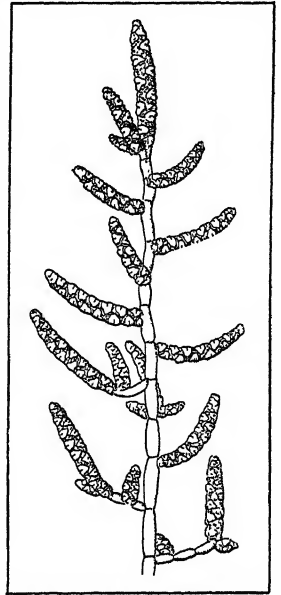
**BURRO WEED** (*Allenrolfea occidentalis*), called also pickle weed and iodine bush, a small shrub of the goose-foot family, found in alkaline marshes from Texas to Utah and California. It grows about 4 ft. high, much branched, with scale-like leaves and small flowers in crowded spikes. Although of much larger size, it strongly resembles the samphire, to which it is closely related.

**BURSA** or **BRUSA**, a city of Turkey in Asia Minor, capital of the vilayet of the same name and located about 20 mi. from the Sea of Marmora. The city presents a lovely picture with its many minarets, kiosks, gardens and bazaars. There are numerous tombs of sultans and of other Moslem notables. It is believed that Hannibal suggested the founding of Bursa, the capital of Bithynia for many years. After a long history of Roman and Byzantine rule, the city was reoccupied by the Ottomans and made the capital of the empire until Murad I removed the seat to Adrianople. During the Greco-Turkish war in 1919-22, Bursa and its environs became the scene of atrocities. At the same period, it figured in the wars of the Turkish nationalists against the sultan's soldiers. Upon the regeneration of Turkey by Mustapha Kemal Pasha, the city had a chance of becoming once more the capital of Turkey, but its proximity to the sea made it undesirable, and ANGORA was chosen instead.

The hot iron and sulphur baths of Bursa have long been famous. The most important industries are the making of richly embroidered prayer rugs and the spinning of silk. Pop. 1927, 127,251.

**BURSE**, a stiff pocket or purse, about a foot square, of cardboard covered with silk to contain the folded CORPORAL. It is placed on the chalice at the beginning and the end of the Mass and on the altar at benediction. The corporal is taken from the burse and laid on the altar under the chalice and also beneath the ostensorium or MONSTRANCE at benediction. The burse is also used for the small container which the priest uses in carrying the BLESSED SACRAMENT to the sick.

**BURSLEM**, an industrial town of Staffordshire, England, 150 mi. northwest of London on the Grand Trunk Canal. Known as the Mother of Potteries in the 17th century it already was famed for its ware. Josiah Wedgwood, born at Burslem of a potter family, in 1759 founded his Ivy House in the town.



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

BURRO WEED  
Flowering spikes



Located here is the Wedgwood Institute which contains a splendid collection of Staffordshire ware. There are also a free library and school, a picture gallery, and other public buildings. Burslem still carries on pottery making. In 1910 it was united with other towns to **STOKE-UPON-TRENT**. Pop. 1931, 42,000.

**BURSTS**, in mining, sudden failures of the walls of **DRIFTS**, **STOSES**, **ENTRIES**, the **PILLARS**, **BACK** or floor to sustain the tremendous load of rock above the mineral. Outbursts are sudden gas emissions which often blow out tons of dust, burying and asphyxiating workmen. *See also* **SQUEEZE**.

**BURTON, ERNEST DE WITT** (1856-1925), American theologian, was born in Granville, Ohio. He was graduated from Denison College, in 1876, and taught for a time in Michigan and Ohio schools. He entered Rochester Theological Seminary in 1879, was graduated in 1882, and the next year entered the Baptist ministry. After holding the chair of New Testament Greek in Newton (Mass.) Theological Seminary, in 1892, he was elected head of the department of Early Christian Literature at the University of Chicago. He was chosen president of the university, July 12, 1923, and served until his death, May 26, 1925, having been an officer of the university for thirty-three years. He edited the *Biblical World* and the *American Journal of Theology*, and collaborated with W. A. Stevens on *Harmony of the Gospels*. In 1921-22 he was chairman of the China Educational Commission.

**BURTON, SIR RICHARD FRANCIS** (1821-90), English traveler, born at Torquay, Hertfordshire, Mar. 19, 1821, educated in France and England. He entered the Indian Army in 1842 and served in Sind under Sir Charles Napier. His mastery of Hindustani, Persian and Arabic enabled him, disguised as an Afghan Pilgrim, to make the daring journey to Mecca (1853) described in his *Pilgrimage to El Medinah and Meccah*. He made an extremely hazardous expedition into the Somali territory, served in the Crimea, and, with Speke, made the journey which led to the discovery of Lake Tanganyika (1858). He traveled for a time in America, and served as consul at Fernando Po, at Santos, in Brazil, at Damascus and at Trieste. He visited Midean (1876-78) and Guinea (1882). He was made a knight in 1886. He died Oct. 20, 1890. He wrote many books, based upon his experiences, and translated the *Arabian Nights*, which is the most celebrated of his literary works.

**BURTON, ROBERT** (1577-1640), English clergyman and writer, was born at Lindley, Leicestershire, Feb. 8, 1577. In 1593 he went to Oxford, and was elected a student of Christ Church six years later. He became vicar of St. Thomas, Oxford, in 1616, and rector of Segrave in 1630. Burton possessed shrewdness, humor, and wide scholarship of a medieval sort, qualities which lend special interest to his best known book, *The Anatomy of Melancholy*. Many bits of wisdom from his work have passed into current sayings. Burton died at Christ Church, Jan. 25, 1640.

**BURTON, THEODORE ELIJAH** (1851-1929), American lawyer and legislator, was born in Jefferson, Ohio, Dec. 20, 1851. After graduating from Oberlin in 1872 he was admitted to the bar in 1875 and began the practice of law in Cleveland. Elected to the House of Representatives in 1889 as a Republican, he served in this body for several periods from 1895-1909 and 1921-27. In 1909 he began his one term in the Senate. From 1904-14 he was a member of the Executive Council of the Interparliamentary Union. Burton was chairman of the Inland Waterways Commission 1907-09, and chairman of the National Waterways Commission 1909-12. A member of the World War Debt Funding Commission in 1922, he was chairman of the United States delegation for the control of traffic in arms, at Geneva, in 1925. President of the American Peace Society between 1911 and 1915, he was again elected to this office in 1925. His publications include: *Financial Crises and Periods of Industrial Depression*, 1902; *Life of John Sherman*, 1906; *Corporations and the State*, 1911; *Some Political Tendencies of the Times and the Effects of the War Thereon*, 1919. He died Oct. 28, 1929.

**BURTON-UPON-TRENT**, a county borough of Staffordshire, England, lying on the Trent, 127 mi. northwest of London. There was a Benedictine abbey, 1002, some fragments of which are embodied in the 18th century Church of St. Mary and St. Modwen, but the former abbott's house in Seyney Park is a half-timbered 15th century structure. Because of abundant sulphate of lime in the water, Burton has been the principal ale brewery in Europe since 1708, though brewing there dated from the abbey. The Bass, Alsopp and Worthington breweries cover some 150 acres over all, employ upward of 6,000, and produce about 3,000,000 barrels annually. Subsidiary occupations of the inhabitants include cask-making. Pop. 1921, 48,909; 1931, 49,485.

**BURU**, an island of the Dutch East Indies, one of the group known as the **MOLUCCAS** and included in the residency of Amboina. Buru lies about 50 mi. west of Ceram and covers an area of 3,250 sq. mi., being 85 mi. long and 50 mi. wide. The surface is mountainous and forest-clad. Mt. Tomahu reaches a height of 8,250 ft. Near the center, at an altitude of 1,900 ft., is Lake Waikolo. Fishing and the manufacturing of cajeput oil are the chief industries. Est. pop., about 20,000.

**BURY, JOHN BAGNELL** (1861-1927), British historian, was born in Ireland, Oct. 16, 1861. He was educated at Trinity College, Dublin, became professor of modern history in Dublin University in 1893, regius professor of Greek there in 1898, and regius professor of modern history at Cambridge University in 1902. He was a Fellow of the British Academy, and a corresponding member of the Imperial Academy of Sciences at Petrograd, the Hungarian Academy of Science, the Rumanian Academy, the Massachusetts Historical Society, and the Russian Archaeological Institute at Constantinople. Among his numerous works are: *Students History of the Roman Empire*

from *Augustus to Marcus Aurelius, The Ancient Greek Historians, and History of the Later Roman Empire*. He also edited Pindar's *Odes* and Gibbon's *Decline and Fall of the Roman Empire*. He died in Rome, June 1, 1927.

**BURY**, a municipal and county borough of Lancashire, England, on the Irwell, 195 mi. northwest of London. The site is Saxon, and a castle once stood on Castle Croft nearby. Flemish immigrants in the reign of Edward III established a woolen trade in the town, but early in the 18th century cotton manufacture eclipsed it. The modern town has schools, museums and other public buildings, and a 10th century parish church rebuilt in 1876. Its industries include cotton manufacture, calico printing, bleaching and dyeing. There also are foundries, machine factories, and a few quarries. Pop. 1921, 56,403; 1931, 56,186.

**BURY ST. EDMUNDS**, a municipal and county borough of Suffolk, England, in a fertile valley on the Lark, 87 mi. northeast of London. In 903 martyred King Edmund was buried in the old monastery that was superseded in 1020 by a Benedictine abbey of which some slight remains survive. Among other remarkable old buildings are St. Mary's with a magnificent carved roof, and St. James's, now a cathedral, of splendid Perpendicular architecture. Carlyle's *Past and Present* was founded on a chronicle of 12th century life in the abbey, and the town is mentioned in the *Pickwick Papers*. Edward Fitzgerald attended the grammar school, and Ouida (Louise de la Ramée) was born at Bury St. Edmunds. The town traffics in cattle, corn and agricultural produce and implements. Pop. 1921, 15,937; 1931, 16,708.

**BUS**, Americanization of the English term, omnibus, known also as motor bus, motor coach and motor stage, a passenger vehicle operated on streets and highways, and propelled commonly by a gasoline INTERNAL COMBUSTION ENGINE. Varying in body design, seating capacity, arrangement of seats, interior appointments, locations and sizes of engines, buses are suitable for transcontinental operation, long inter-city runs, suburban routes, charter service, sightseeing trips, de luxe limited-stop service, local city services and as feeders or supplements to other transportation lines. They also are used extensively by schools, and to a limited degree by hotels, resorts and private companies. In public service they operate over definite routes on regular schedules with certain prescribed rates of fare.

Accelerated in the beginning by the use of automobiles for commercial traffic the bus has developed rapidly from 1915 to the present day. Greater carrying capacity, higher powered engines, faster acceleration, better braking ability, greater strength and longer life of parts, increased reliability, specially-designed chassis, lower center of gravity, numerous mechanical improvements, and new types of bodies have resulted in the safe, comfortable, reliable, efficient buses of to-day.

At the beginning of 1932 almost 100,000 buses were

in use—14,350 for city service, 34,150 for inter-city runs, 2,500 for sightseeing, 47,000 for schools and 2,300 for other non-revenue operations. The total industry investment for vehicles, terminals and garages was \$600,000,000. During 1931 the 51,000 revenue buses carried 1,804,000,000 passengers and received \$330,000,000 in revenue. C. A. F.

**BUS-BARS**, electrical conductors associated with a SWITCHBOARD, into which current from the various generators (see ELECTRIC GENERATORS) is collected and from which power to various feeders is delivered. In substations and industrial plants the bus-bars may be supplied from incoming feeders. For low voltages, flat copper or aluminum bars separated by spacers are used as bus-bars; for higher voltages, insulated cables located within masonry vaults; for very high voltages, copper tubing mounted outdoors on INSULATORS.

**BUSBY, RICHARD** (1606-95), English schoolmaster, was born in Lutton, Lincolnshire, in 1606. He was educated at Westminster School and at Oxford. Busby was headmaster of Westminster School from 1638 to his death. He was a successful teacher and had the reputation of having "bred up the greatest number of scholars that ever adorned age or nation." Dryden, Locke and Robert South were among his pupils. He published a number of expurgated editions of the classics for school use. Busby died on Apr. 6, 1695.

**BUSH-BUCK**, the African harnessed antelope. The species vary in size, the mountain bush-buck being as large as a pony. The smallest is the true bush-buck (*Tragelaphus scriptus*), a beautiful little spotted creature no bigger than a goat. White lines and vertical stripes, marking the bright rufous coat, simulate a harness. The horns, peculiar to the male, describe an open spiral. Bush-bucks lie up in the forest by day, appearing only toward dusk. Their alarm call is a loud baboonlike bark.

**BUSHEL**, a measure of capacity for grain, potatoes, fruit and other dry material. The imperial (British) bushel contains 2218.192 cu. in., and the Winchester bushel, which became the legal standard in the United States, contains 2150.42 cu. in., or about  $1\frac{1}{4}$  cu. ft. It contains four pecks, each peck containing eight quarts. The various states prescribe the weights of bushels of various commodities. A bushel of potatoes, for example, is usually taken as weighing 60 lbs. Such commodities are coming to be sold by weight instead of by the bushel. See MEASURE, UNITS OF.

**BUSH HONEYSUCKLE**, a name given in America to the native species of *Diervilla*, handsome, free-flowering, deciduous shrubs closely allied to the weigelas of gardens. They strongly resemble the true honeysuckles from which they differ chiefly in producing a slender dry fruit pod or capsule instead of a berry. The common bush honeysuckle (*D. Lonicera*), a low, spreading shrub found from Newfoundland to Manitoba southward to North Carolina and Wisconsin, is frequently planted for ornament.

**BUSHIDO**, a word used in Japan to signify the rules of knightly or chivalrous conduct. It comprises

a vast body of unwritten laws and precepts of knight-hood, the chief elements of which are courage, truthfulness, loyalty, filial piety, politeness, honor and respect for women. Bushido was an outgrowth of feudalism tintured with Buddhism and Confucianism. Its laws were formulated by the end of the 12th century, ready to be passed on orally from one generation to the next. Bushido governed the lives of the *samurai*, Japanese warriors of noble blood, noted for their courage, their revengefulness and their acceptant attitude toward suicide. Though the *samurai* were abolished in the 19th century, bushido still survives in Japan.

**BUSHMAN**, a group of moribund South African dialects spoken by at most 50,000 persons. Their chief characteristic is the use of eight inspired consonants called "clicks"; and they are presumably related to the languages of the Congolese pygmies, though lack of material has thus far rendered comparative study inconclusive.

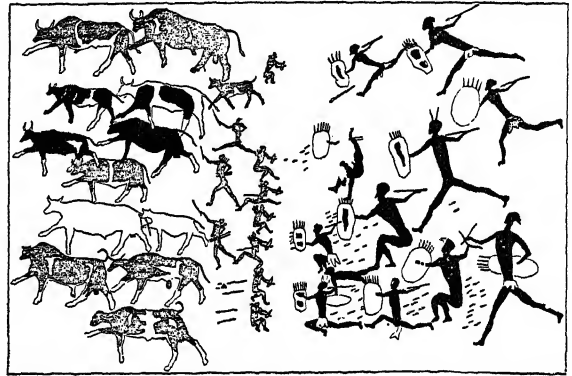
**BIBLIOGRAPHY.**—W. H. Bleek and L. C. Lloyd, *Specimens of Bushman Folklore*, 1911.

**BUSHMASTER**, a popular name for a species (*Lachesis mutus*) of pit viper found in South America about the Amazon and in the Guianas. It is one of the largest of poisonous snakes, often some 7 to 8 ft. in length. A specimen 12 ft. long has been measured. It is light yellow in color, with dark brown markings on the back. This snake is a cousin of the fer-de-lance and the rattlers. It has the rudiments of a rattle on its tail. When excited it vibrates the tail rapidly, and this, striking against dry leaves, produces a warning sound. The poison is extremely virulent and may cause death within 10 minutes.

**BUSHMEN**, a nomadic people living in the central and northern portions of the Kalahari desert and the northern half of southwest Africa. That they formerly occupied the whole of South Africa is evidenced by their rock paintings and skeletal remains. With the exception of the Hottentots, who are an offshoot, the Bushmen are easily distinguishable from all Africans. Their skin is yellow or yellow brown; their average height is about 60 inches, and their feet and hands are small. Their hair which is sparse and short is arranged in many small tight coils.

Edible roots and vegetables gathered by the women and animals hunted and killed by the men with poisoned arrows are the Bushmen's means of livelihood. They practice neither agriculture nor cattle raising. Several independent hunting bands, of from 50 to 100 members each, comprise a tribe. Individual bands are loosely governed by the older men; only the bands in the northwest having a nominal and hereditary chief. Monogamy is customary, though polygamy is practiced. The Bushmen are a particularly gay and cheerful people with a great love of dancing and singing. In many of their dances, extraordinary ability in imitating the appearance, manners and cries of animals and persons is shown. Their language is distinguished from that of all other peoples, except the Hottentots, and is composed of a

series of peculiar clicks. Little is known of the Bushmen's religious beliefs and customs. They worship celestial bodies, chiefly the moon. Medicine men and women formerly had great influence.



COURTESY AMER. MUS. OF NATL. HISTORY

BUSHMEN DEFENDING THEIR HERDS FROM A BAND OF ZULUS  
From a rock painting

**BUSHRANGERS.** See GUERRILLA WARFARE.

**BUSH TIT**, a genus (*Psaltiriparus*) of titmice native to the western United States and Mexico. They are very small delicate birds, only about  $4\frac{1}{2}$  in. long, with soft plumage grayish or brownish above and light below. In habit they are active and sociable, frequenting the underbrush on hillsides or along streams. Bush tits are very skillful in building their nests, which are large, bulky, purse-shaped structures, sometimes a foot long and about 4 in. in diameter, suspended from low branches and provided with a tiny entrance near the top. In these nests they lay 5 to 9 pure white eggs. The best known species is the least bush tit (*P. minimus*), found from Washington to California.

**BUSINESS ADMINISTRATION, SCHOOLS OF.** With the growth of business and the consequently widening opportunities and responsibilities, there has been an increasing demand for the specially trained executive, and universities throughout the United States have established schools of business or added courses in business training to their curriculums. The need for schools of business of collegiate rank was recognized by Gen. Lee when president of Washington and Lee University (1869), but it was the University of Pennsylvania which first opened such a school, the Wharton School of Finance and Economy, in 1881. Not until 17 years later did any other college feel the time had come to include training in business administration in the college curriculum. In 1898 the University of Chicago and the University of California opened Schools of Commerce. Before 1908 only six colleges or universities had established schools of business. By 1930 there were nearly 200 schools or departments of business of college rank, and over 400 colleges and universities were giving courses in business administration and organization, merchandising methods and allied subjects. The curriculum and entrance requirements in these schools of business vary widely. Those colleges giving four-

year courses admit high school graduates, while those giving two-year courses demand two or three years of preliminary college work. There has been a constantly growing cooperation between organized business and these schools of business in working out and developing a practical curriculum. M. R.

See L. Marshall, *Collegiate Schools of Business*, 1928.

**BUSINESS COLLEGES**, a term used for schools specializing in commercial subjects. They are not, as their name would indicate, of collegiate standing. See COMMERCIAL SCHOOLS.

**BUSINESS CYCLES.** Students of the SOCIAL SCIENCES conceive of a cycle as being the recurring succession of certain events or phenomena in some phase of social life. In the phrase Business Cycles, the word business means not only trade and COMMERCE but it embraces in its meaning also all of the community activities upon which trade and commerce depend; in other words, business means all organized economic activities of the community which have to do directly or indirectly with trade and commerce. Business Cycles then are the recurring succession of changes in, or fluctuations of, the business activities of organized communities.

In each business cycle there is an occurrence of a succession of events which are similar to, though different from, the succession of events which happened in previous business cycles. In other words, not all business cycles are exactly the same in the succession of events. Some business cycles are larger or more intense than are others. Each business cycle occupies a certain period of time in completing its phenomena, though not all business cycles are of the same duration. There is then not the same kind of regularity of duration, intensity, or succession of events in business cycles that is found in the repetition of natural phenomena, such as the recurrence of the seasons. Nevertheless, there is sufficient regularity of recurrence of business fluctuations in general to justify the designation of the phenomena as business cycles.

Each business cycle is broken up into different phases or periods, such as the prosperity or boom phase, the crisis phase, the depression phase and the recovery phase, but all cycles do not have the same phases. Each phase of a cycle has certain distinguishable characteristics: A boom is always characterized by rapidly rising prices, inflation of bank credit (see BANKING), speculation in commodities and securities, rising wages, and high profits. A period of depression is always distinguished by falling prices, business failures, decline in bank credit, falling wages and unemployment. The outstanding feature of each phase of every cycle is the change in the general price level. It is largely in terms of changes in the general price level that the analyses of business cycles are made.

There are at least two kinds or species of business cycles. First, we have the inflation boom species of fluctuations in the general business conditions which are commonly called Major Business Cycles; and second, there are the mild non-inflational fluctuations in

general business conditions which are generally called Minor Business Cycles. There can be no major business cycle without a rapid rise in the general price level made possible by bank credit inflation of the money in circulation, but bank credit inflation is not a characteristic feature of the mild price fluctuations of the minor business cycle.

Fluctuations in the general price level are an outstanding feature of both major and minor business cycles; but the price swings are much greater in the case of major cycles than in the case of minor ones. The extent of the price swing is not the only characteristic which distinguishes the one from the other. The nature of the price movements of the major cycle differ greatly from those of the minor cycle.

The price fluctuations of a major business cycle consist of the following characteristic movements: First (the boom), a period of a rather rapid upward swing of the general price level made possible by a rapid expansion of bank credit; second (the crisis), a sharp downward trend in the general price level, and (the depression) a continuation of a slower downward movement in the price level while bank credit is being deflated; and, third (the recovery), a slow, irregular and "spotted" upward trend in the general price level until it reaches a comparatively stable trend. The span of time covered by these three marked periods of price movements may be from three to eight years.

Ordinarily the price movements of a minor business cycle occur about as follows: First (an apparent equilibrium), a period of a comparatively stable price level and little or no evidence of the inflation of bank credit; second (the depression), a period of slight but perceptible decline in the price level and some contraction of bank credit; third (the recovery), some expansion of bank credit and the stabilization of the price level somewhat above the lowest point reached in the previous decline but not necessarily at the exact level which prevailed prior to the decline. The span of time covered by the last two phases may be from six months to two years, whereas the first may last for several years.

The United States has gone through several major business cycles and has experienced many more minor ones. In 1837 a major boom terminated in a crisis and a succeeding depression; again in 1873 the Civil War boom terminated in a crisis which was followed by a depression. In 1893 a business boom was brought to a close by a severe crisis which was followed by a long period of depression; then in 1907 another boom was brought to a close by a crisis. The World War brought about the biggest boom it has ever known; this boom was terminated by the crisis of 1920. Again in 1930 a serious depression occurred in the United States.

In between each of the major business cycles one or more minor cycles have occurred. There were slight business depressions in 1848, in 1858, in 1860, and in 1887. Since 1900 there have been several minor business depressions or recessions. In 1903 a

slight one took place, and in 1913-1914 another one occurred. Since 1920 there have been two marked recessions in business: In 1923 a slight one occurred which lasted on into 1924; again in 1929 the stock market crash occurred and was followed by a depression which developed into serious proportions.

All business fluctuations are due to changes in the prospect of profits from business enterprises. The introduction of new inventions into industry which bring about new processes of production and new kinds of goods, and the exploitation of natural resources, offer new and large prospects of profits to those who invest in them. When large quantities of bank credit are used to take advantage of securing such prospective profits the general price level is pushed up rapidly and a boom occurs. The boom is the first phase of the major business cycle, and the other phases of crisis, depression and recovery will inevitably follow in their natural order. The boom movement of the major business cycle can not occur unless bank credit is inflated sufficiently to permit the cumulative upward movement of the general price level. It is possible to eliminate the major business cycles through the control of the expansion of bank credit. The Federal Reserve Board (*see* FEDERAL RESERVE ACT) has effectively controlled the expansion and contraction of bank credit since the recovery from the crisis of 1920.

It is believed by many students of the problem that the fundamental cause for the occurrence of the minor business cycle is the occasional accumulation of surplus stocks of goods or over-investments in circulating capital goods in the form of finished goods which cannot be sold at a profit. When this fact of surplus stocks is realized by business enterprises they attempt to reduce them by curtailing production and throwing the surplus goods on the market. This action on the part of business enterprises brings about the business depression. The minor business cycle, then, is caused by, or due to, an imperfect working of our capitalist-competitive-profit system. At all events, the minor business cycle is not essentially a bank credit phenomenon, and its occurrence could not be avoided by the control of bank credit.

The business cycle which was evidenced by the severe depression of 1930-32 had some of the characteristics of a major cycle while other characteristics of such a cycle were absent. The business depression of 1930-32 was not preceded by a boom in commodity prices, but it was preceded by a boom in the prices of securities. In 1928-29 there was great inflation of bank credit in the securities market, but little inflation of bank credit in the commodity market. The end of the stock market boom in 1929 was followed by a crisis in the securities market but there was little evidence of a real crisis in business in general, though in 1930-32 a serious depression in business in general followed the 1929 crisis in the stock market. *See also* CRISIS; PANICS.

A. B. A.

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**BUSINESS FORECASTING**, an operation of two kinds: the forecasting of some specific business fact such as next year's production of Pig Iron, or the forecasting of general business conditions (*see* BUSINESS CYCLES). Forecasting specific business phenomena usually rests upon the determination of the force of the SECULAR TREND, then upon the measurement of the usual seasonal variation, and finally upon an estimate of the influence of the cyclical factor upon the phenomena in question. The synthesis of the various forces that have affected the phenomena in the past, upon the assumption that these separate forces will continue to operate in the immediate future in about the same fashion that they have operated in the past, enables one to arrive at a specific forecast for the factor in question.

Specific forecasts are also made by observing the regular sequential movements that occur in series related to the one in question. When, for example, it has been determined that in the past the unfilled orders of United States Steel Corporation, the price of iron and steel scrap, the price of the common stock of the United States Steel Corporation, and the price of pig iron all tend to move in a more or less regularly established time sequence, it is possible to forecast changes in pig iron prices on the basis of changes in the factors that usually precede it in movement. The method is hazardous unless it is reasonable to assume some causal relationship between the factors.

The forecasting of changes in general business conditions is a much more complicated and difficult problem. "General business condition" is a composite of a large number of individual factors. The simplest explanation of what is usually meant is that it refers to the general tempo at which business activity moves. It measures the general volume or aggregate of business transactions taking place at a given time. A number of composite indexes such as those constructed by the Federal Reserve Board (*see* FEDERAL RESERVE ACT), the American Telephone and Telegraph Company, the Harvard Economic Society, and by various other private statistical organizations (*see* STATISTICS), are available to appraise the condition of general business at any particular time. General business forecasting involves the foretelling or prediction of the direction in which such composite indexes are expected to move and the extent of the movement with some idea as to the timing of the various turning points or changes in direction that they may take. In the opinion of many it is hopeless to try to forecast general business conditions. The commercial statistical organizations engaged in making such forecasts are often accused of quackery. However, under the auspices of several academic institutions, careful experiments are being conducted to determine whether or not such forecasting is scientifically feasible. Unfortunately, it is not possible to state that these experiments have thus far been very successful.

The methods employed in general business fore-



casting by those organizations that are most worthy of consideration vary to a slight extent. Very little reliance is placed upon the purely mechanical movements forecasting series. Generally speaking, the forecasts of these institutions are the results of careful scrutiny and study of a fairly large number of individual statistical series reflecting the activity of various economic or business functions. The course of interest rates (*see* INTEREST), the volume of CREDIT extended, the general price level, the volume of retail trade, the volume of wholesale trade, and the volume of manufacture are series that must be studied in order to get a general picture of what is taking place in the business structure. When any one of these indexes gets out of alignment it indicates that a maladjustment exists in the structure which may lead to evil results. It is in the close examination of these series that forecasters read the signs of the time and form their conclusions. D. H. D.

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**BUSINESS ORGANIZATION.** *See* ORGANIZATION, INDUSTRIAL.

**BUSIRIS**, mythological king of Egypt. During a famine of nine years in Egypt, a seer told him that it would cease if every year he sacrificed a foreigner to ZEUS. Busiris began by slaying the seer, but when he seized Heracles this hero broke his bonds and killed Busiris instead.

**BUSKINS**, ceremonial stockings of silk reaching to the knees, sometimes ornamented with gold thread, worn over ordinary stockings by the celebrant of a pontifical Mass.

**BUSONI, FERRUCCIO BENVENUTO** (1866-1924), Italian pianist, was born at Florence, Apr. 1, 1866. He appeared in public at the age of eight and later studied under W. A. Remy. At the age of 18 he was elected a member of the Bologna Philharmonic Academy and in 1888 began teaching at the Helsingfors Conservatory, where he remained five years. In 1890 he was appointed professor at the Moscow Imperial Conservatory, and the following year joined the faculty of the New England Conservatory of Music. He returned to Europe in 1893, and toured extensively. During 1909-11 he toured the United States, and in 1913 became director of the Bologna Conservatory. He received from France the Chevalier's Cross of the Legion of Honor. Although his own compositions are now infrequently performed (they include an opera, *Die Brautwahl*, two symphonies, two concertos and shorter works for the pianoforte), his transcriptions of Bach are genuine masterpieces. He died at Berlin, July 27, 1924.

**BUSS, FRANCES MARY** (1827-94), English educator, was born in London, in 1827. She was educated in a Camden Town school and taught there until she went to her mother's school in Kentish Town. This became the North London Collegiate School for Ladies and was highly recommended by the schools Inquiry Commission. Miss Buss helped promote the Girls' Public Day School Trust, and worked for colleges for women and for improvement

in training teachers. She died at London, Dec. 24, 1894.

**BUSTARDS**, a family (*Otididae*) of Old World game birds allied to the cranes and plovers, found chiefly in dry open plains. They are bulky birds with rather long necks, large wings and strong legs and feet. The great bustard (*Ous tarda*), prized for game since ancient times, is the largest European land bird, an adult male measuring 4 ft. in length and weighing as much as 30 lbs. In color it is russet with black bars above and white below. The head and neck are pale gray and the wings largely white tipped with black. It feeds chiefly on seeds and tender plants and nests in a slight depression scratched in the ground, laying 2 or 3 large, spotted, greenish eggs. To attract a mate the male parades with drooping wings and elevated tail and expands to an enormous size a large pouch on its throat. Although formerly abundant, the great bustard is very rare in western Europe and Great Britain, occurring now chiefly in eastern Europe, Asia and northern Africa. The little bustard (*O. tetrax*) of Mediterranean countries, barely 17 in. long, is also a well-known game bird.

**BUTANE**, the fourth member of the paraffin series (*see* PARAFFIN COMPOUNDS) of HYDROCARBONS. Butane has the chemical formula  $C_4H_{10}$ . It is a gas under ordinary conditions (melting at  $-135^\circ C.$ ; normal boiling point  $-0.6^\circ C.$ ), but may be liquefied under pressure up to  $153.2^\circ C.$  The specific gravity of the liquid is 0.5845. *Iso-butane* has the same chemical formula as normal butane, but differs in molecular arrangement, i.e.,  $CH_3-CH_2-CH_3$ .



Most of the physical properties of iso-butane are intermediate between those of PROPANE and normal butane. The butanes are components of crude PETROLEUM and of NATURAL GAS. Mixtures of the butanes are produced commercially as by-products of the RECTIFICATION of GASOLINE recovered from natural gas, and are distributed in pressure cylinders for use as fuel. *See also* GASES, LIQUEFIED.

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**BUTANOL.** *See* BUTYL ALCOHOL.

**BUTE, JOHN STUART**, Third Earl of (1713-92), British prime minister and botanist, was born at Edinburgh, Scotland, May 25, 1713. He was educated at Eton, and entered parliament in 1737 as one of the Scottish representative peers. In 1751 he became tutor to Prince Frederick, and later to George III. Two days after mounting the throne, in 1760, George III made Bute member of the privy council, and the next year he became secretary of state. After Pitt's resignation Bute was appointed prime minister, serving during 1762-63. He was responsible in a large measure for the fall of Chatham in 1761, the disruption of the Prussian subsidy treaty, the war with Spain, 1762, and the levy of the impractical cider-tax, 1763. In 1772 he retired and devoted himself to

writing the *Botanical Register*, a nine-volume work of which twelve magnificent copies were published, at a cost of \$12,000. He died at London, Mar. 10, 1792.

**BUTE**, an island of Scotland, in the Firth of Clyde. It lies about 40 mi. from Glasgow by water and comprises an area of 50 sq. mi. Its length is about 15 mi. and its maximum width about 5 mi. The northern part is mountainous. Near the center are three small lakes. Rothesay and Mountstuart are the principal towns. The island possesses valuable fisheries. Pop. 1921, 20,000.

**BUTLER, BENJAMIN FRANKLIN** (1818-93), lawyer, soldier and public official, was born in Deerfield, N.H., Nov. 5, 1818. He studied law at Waterville (now Colby) College, and began in 1840 at Lowell, Mass., a practice which won him wide repute. Entering politics, he became one of the leading Democrats of New England. At the Charleston convention he supported the faction which nominated Breckinridge and divided the party. He entered the Union Army and had command of the departments of the Gulf and South Atlantic. He received notoriety for his famous order designating slaves as "contraband of war" and for other civil regulations. After the war he served in Congress as a Republican for 10 years. Defeated in 1874, he returned to the Democratic Party, and in 1882 was elected governor of Massachusetts. He was the Presidential nominee of the Greenback Party in 1884, having denounced Cleveland as the Democratic nominee. He died in Washington, D.C., Jan. 11, 1893.

**BUTLER, NICHOLAS MURRAY** (1862- ), American educator and publicist, was born at Elizabeth, N.J., Apr. 2, 1862. He graduated from Columbia University in 1882, took his Ph.D. there in 1884 and studied at Berlin and Paris 1884-85. From 1885-1902 he was successively assistant in philosophy, tutor, adjunct professor, dean of the faculty of philosophy and professor of philosophy and education at Columbia University. During this period he organized the New York College for Training of Teachers, now called Teachers College and affiliated with Columbia University, and served as its first president 1886-91. In 1902 he became president of Columbia and through his able administration of the university has been recognized as one of the foremost American educators. Butler has been very active in national politics and in the study of international problems. In 1910 he became trustee of the CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE, and in 1925 president of the organization. He was the founder and editor of the *Educational Review* 1889-1920 and became the editor of the *Great Educators Series* in 1892. Butler was awarded, with JANE ADDAMS the Nobel Peace Prize in 1931. Among his writings are *Education in the United States*, 1910; *The International Mind*, 1913; *The Path to Peace*, 1930, and *Looking Forward*, 1932.

M. R.

**BUTLER, SAMUEL** (1612-80), English satirist, was born at Strensham, Worcestershire, Feb. 8, 1612.

In his 17th year he became attached to the household of the Earl of Kent. Later, leaving this service, he was successively attached to the household retinues of many country estates. During this period he wrote much of *Hudibras*, the famous satirical poem which held the Puritans up to ridicule. The publication of the first part of *Hudibras* in 1663 brought Butler instant fame, but did not serve to relieve his poverty; the second part appeared in 1664, and the third in 1678. *Hudibras* is a masterpiece of bright couplets, many of which have become proverbs. Butler died Sept. 25, 1680.

**BUTLER, SAMUEL** (1835-1902), English writer, was born at Langar, Nottinghamshire, Dec. 4, 1835, the son of a clergyman. He was educated at Cambridge, and at 24 went to New Zealand to raise sheep. After 1864 he resided in London, dividing his time between writing, painting and music. Butler thrived on controversy of all sorts, and his voice was heard in many questions touching the arts and sciences. Some of the theories first advanced by him on the subject of biological evolution, which he conceived as depending largely upon the inheritance of unconscious memory, are somewhat accepted. His best weapon was his genius for satire, as is demonstrated in his two Utopian books, *Erewhon*, 1872, and *Erewhon Revisited*, 1901; stories of an imaginary land. But Butler's most distinguished work is undoubtedly his novel, *The Way of All Flesh*, 1903. Among his other books are *The Fair Haven*, 1873, *A Psalm of Montreal*, 1875, *Life and Habit*, 1877, *The Deadlock in Darwinism*, 1890, the beautiful *Alps and Sanctuaries*, 1891, and a biography of his grandfather, *The Life and Letters of Dr. Samuel Butler*, 1896. Selections from his *Notebooks* were published in book form in 1912. The writer died in London, June 18, 1902.

**BIBLIOGRAPHY.**—H. F. Jones, *Samuel Butler*, 1919; C. E. M. Joad, *Samuel Butler*, 1924; M. Garnett, *Samuel Butler and his Family Relations*, 1926.

**BUTLER**, a city of western Pennsylvania, county seat of Butler Co., on the Cohoquenessing Creek 35 mi. north of Pittsburgh; it is served by four railways, bus lines and a nearby airport. Agricultural products, chiefly potatoes, wheat, oats and corn, are valued at about \$3,000,000 annually. In 1929 manufactured products, valued approximately at \$33,000,000, consist primarily of railroad cars, plate glass, oil well machinery, automobiles, petroleum products and metal pipe. Butler has oil and natural gas wells. The retail trade during 1929 amounted to \$17,842,219.

Butler was settled about 1800 and three years later the borough was incorporated; it was chartered a city in 1917. Pop. 1920, 23,778; 1930, 23,568; about 9% foreign-born.

**BUTLER UNIVERSITY**, at Indianapolis, Ind., a coeducational and privately controlled institution, comprising Butler College, College of Religion, and affiliated and associated institutions. It was chartered in 1849 as North Western Christian University, and given its present name in 1877. Butler College was adopted in 1896 as the name of the undergrad-

uate organization. The university in 1931 had productive funds amounting to \$1,965,221. The library contains 52,000 volumes. In 1931-32 there were 2,300 students, and a faculty of 105 headed by Pres. ROBERT JUDSON ALEY.

**BUTT**, a measure of capacity of the value of two HOGSHEADS, formerly used chiefly in measuring wine and ale; also, any large cask or barrel. Butt is used in general of the large end of something, as of a log. It is also applied to the end of a plank which is laid endwise to another and to the joint between two such members.

**BUTTE**, a conspicuous, isolated, flat-topped hill, descending to the level in precipitous cliffs. The name was formerly applied in the western United States to any sudden eminence, Mt. Shasta being known as Shasta Butte. Buttes are numerous in the elevated plateau region of the Great Plains, especially in the arid southwest. They represent erosion remnants of former plateaus, having persisted because of a cap of hard resistant rock which protects weaker strata beneath. Wind work and rain-erosion are wearing down the buttes, many of which assume toward the summit a turretlike form.

When broad enough at the summit to be termed a table-mountain, such a formation becomes a MESA. The distinction between buttes and mesas, being merely one of extent, is ill-defined. Towerlike remnants of volcanic necks are sometimes called buttes. *See also* MONADNOCK.

**BUTTE**, an important mining city in southwestern Montana, the county seat of Silver Bow Co., situated 45 mi. southwest of Helena, on the western slope of the Rocky Mountains. It is served by airplanes, buses and five railroads. Butte is built up on a hill containing mostly copper. Gold, silver, lead and zinc are also found here. In 1929 the industrial output reached an approximate total of \$5,000,000; the retail trade in 1929 amounted to \$33,576,970. At one time the smelting ruined the vegetation, but now that the smelting is done elsewhere Butte has attractive homes, gardens and parks. Silver was the leading interest, until the price fell in 1893. Copper became important in 1882, and in 1900 nearly half the world's output of copper was produced here. Butte was founded in 1866 and incorporated in 1879. Famous hot springs and the Lewis and Clark National Monument are near by. Butte is the seat of the Montana State School of Mines, a department of the State University. Pop. 1920, 41,611; 1930, 39,532.

**BUTTER**, the fatty solid obtained by the churning of MILK or cream. Normally the product contains about 81% of milk fat (also called butterfat), about 15% of moisture, about 2½% of salt, and small quantities of curd, sugar, and ash. The color of butter varies from a pale to a deep yellow, depending largely on the breed of cows and their feed. The yellow color is most pronounced when the cattle are on good pasture or are receiving other succulent feed rich in the natural pigments, carotin and xanthophyll, that occur in fresh forage. To maintain uniformity

in the color of butter throughout the year, harmless artificial coloring matter is commonly used.

Physically, butter is a form of emulsion, the stability of which is increased by the working process; unworked butter is "leaky," a term signifying the separation of water from the butter. Chemically, milk fat, the principal constituent, consists chiefly of the GLYCERIDES: butyrin, caproin, laurin, myristin, palmitin, and olein. Under the Federal Food and Drugs Act of June 30, 1906, butter is "understood to mean the food product usually known as butter, and which is made exclusively from milk or cream or both, with or without common salt, and with or without additional coloring matter, and containing not less than 80% by weight of milk fat, all tolerances having been allowed for."

In commercial manufacture in the United States butter is made chiefly in creameries equipped with power machinery, including pasteurizers to insure that the cream used is free from organisms injurious to health. After being churned, the butter is washed to remove the BUTTERMILK, then worked, and finally packed into tubs, boxes, or cartons for market. Its quality is judged by its flavor, aroma, texture, and color which are collectively appraised in accordance with a system of commercial grades.

#### CREAMERY BUTTER PRODUCTION

In Factories in the U. S.

5-Year Average, 1925-29

Division	Production (Pounds)	% of Total
UNITED STATES .....	1,478,773,000	100.0
LEADING STATES:		
Minnesota .....	268,639,000	18.1
Iowa .....	182,608,000	12.3
Wisconsin .....	153,589,000	10.4
Nebraska .....	92,680,000	6.2
Ohio .....	78,564,000	5.3
California .....	72,797,000	4.9
Michigan .....	68,273,000	4.6
Missouri .....	67,413,000	4.5
Illinois .....	62,285,000	4.2
Indiana .....	59,500,000	4.0

A product known as renovated butter is obtained by melting, purifying, and otherwise treating butter of poor flavor. Whey butter is the product obtained from cream separated from whey. Unsalted butter is butter to which no salt has been added, a kind preferred by some consumers. The annual production of butter in the United States is about 2,000,000,000 lbs., which is greater than that of any other country. The term butter is applied also to various industrial and food preparations having a buttery consistence. *See also* MILK. J. R. M.

**BUTTER AND EGGS**, a name given in the United States to the TOADFLAX (*Linaria vulgaris*), a handsome, smooth, leafy herb of the figwort family with yellow and orange flowers, growing widely in fields and in waste places.

**BUTTERCUP**, the common name for various species of CROWFOOT (*Ranunculus*) having conspicuous bright yellow flowers. Among these are the

meadow or tall buttercup (*R. acris*), widespread in Europe and Siberia, and profusely abundant as a weed in the northern United States and Canada, and the creeping buttercup (*R. repens*), of similar range,



COURTESY IOWA GEOL. SURV.

BUTTER AND EGGS

troublesome as a weed in Great Britain and introduced into eastern North America. The more showy native American species include the marsh buttercup (*R. septentrionalis*), abundant in wet places from New Brunswick to Manitoba and southward, and the California buttercup (*R. californicus*), of the Pacific coast, which colors large areas brilliant yellow in early spring. The double-flowered buttercup (*R. repens pleniflorus*) and the turban or Persian buttercup (*R. asiaticus*) with headlike double flowers, are widely grown in gardens.

**BUTTER-FAT.** See FATS.

**BUTTERFISH**, a name given to several fish of different families. It is most commonly applied to the species (*Poronotus triacanthus*), also called in different localities harvest fish, dollarfish, and pumpkinseed. In the summer, this excellent food fish is abundant on the Atlantic coast from Maine to South Carolina. The small oval-bodied butterfish are from 6 to 10 in. long, blue above and silvery below. As they are easy prey for larger fish when young, a group of 12 or more often seek safety beneath the tentacles of a jellyfish or sun squall. They obtain some food in this way, but are also subject to the deadly sting of the jellyfish and risk being caught in its tentacles. A blenny or gunnell (*Pholis gunnellus*) abundant in the North Atlantic is also known as butterfish.

In 1929 the total commercial catch of butterfish in United States waters, taken mostly along the coast from New England to Chesapeake Bay, amounted to 14,248,000 lbs. with a value of \$977,000.

**BUTTERFLY.** Day-flying insects of the order *Lepidoptera* (super-family *Papilionoidea*) are butterflies. The wings of the adults are membranous and covered with over-lapping scales, similar to the wings of moths. The antennæ of butterflies are club-shaped. With the exception of a few tropical species, butterflies fly only in the daytime. When at rest, the wings are held erect above the back. The mouth-parts consist of a long tube or proboscis. Many species of butterflies feed on nectar in flowers. Metamorphosis is complete. Eggs are usually laid on the food plant of the larva. The larvæ (caterpillars) feed on vegetation, some species being injurious to crops. When ready to pupate, a naked chrysalis is formed, usually suspended from some support.

**BUTTERFLY FISH**, the name given to a numerous family (*Chaetodontidae*) of mostly small, very active, highly colored fishes found in tropical waters throughout the world. Many are strikingly beautiful, with a varied coloration chiefly yellow marked with black. They have strongly compressed bodies, small mouths, bristle-like teeth and spinous fins. Several species are found in Florida waters and along the Gulf coast; a few range sparingly northward to New England.

**BUTTERFLY-LILY** (*Calochortus*), a group of small corm-bearing plants native to western America, with showy flowers, several of which, called also MARIPOSA LILY and globe tulip, are sparingly grown as ornamentals.

**BUTTERFLY PEA** (*Clitoria mariana*), a handsome somewhat twining perennial native to dry soils in the southern United States. It grows from 1 to 3 ft. high, with smooth leaves of 3 leaflets and showy fragrant pale blue flowers, borne singly or in small clusters.

**BUTTERFLY WEED** (*Asclepias tuberosa*), called also pleurisy-root, a rough-hairy perennial of the MILKWEED family, native to dry soils from Maine to Minnesota and southward to Florida and Arizona and sparingly grown as a border plant. The very leafy much-branched stems, 1 to 3 ft. high, bear numerous showy clusters of bright orange-colored flowers, followed by long, hoary seed pods. Butterfly weed, formerly of repute as a remedy for pulmonary affections, dysentery and rheumatism, was used by the Indians in treating pleurisy. They also extracted a crude sugar from its flowers and used the pods in cooking.

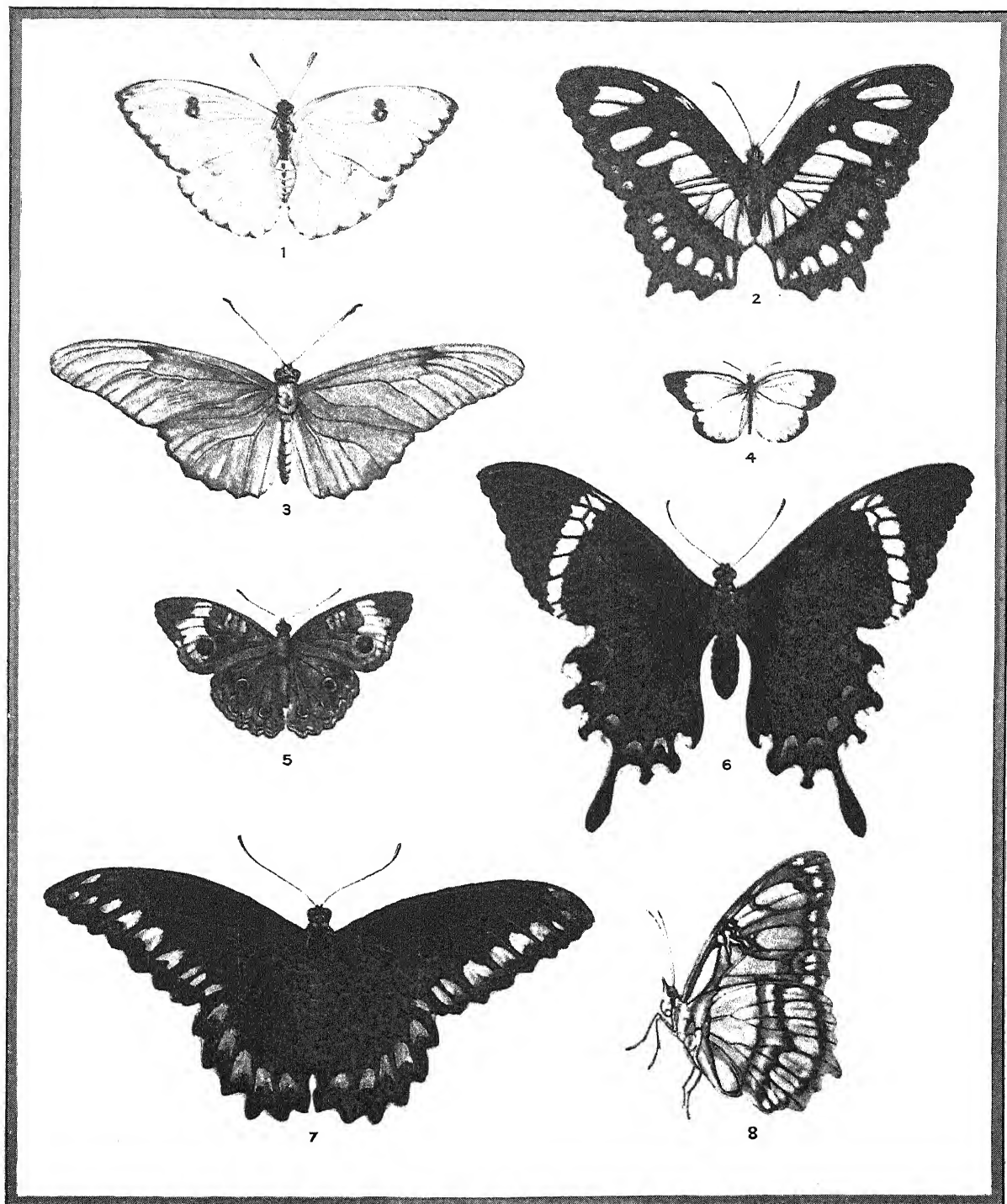
**BUTTERMILK**, the milk left after separation of butter from ripened (soured) cream. It is also made by souring skimmed or whole milk by adding cultures of lactic acid bacteria. Part of the milk sugar is fermented to lactic acid, alcohol and carbonic acid, and the protein casein is finely coagulated. The nutritive value of buttermilk is the same as that of skimmed milk, except when it is made from whole milk. See also MILK.

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**BUTTERMILK FALLS**, a state park in Tom Co., 2½ mi. south of Ithaca, N.Y. The park was created in 1924 and contains 350 acres. Within the park, Buttermilk Creek descends more than 500 ft. in a series of rapids, cascades and waterfalls. Above one of the falls, Pinnacle Rock rises 40 ft. in the center of the stream.

**BUTTERNUT** (*Juglans cinerea*), a short-trunked, widely branched tree of the WALNUT family called also white walnut. It grows usually in rich, moist soil from New Brunswick to South Dakota and southward to Virginia and Arkansas. The tree differs from the black walnut in its smaller size, more widely branching trunk, soft, coarse-grained, light brown wood and elongated, four-ribbed nuts borne in small clusters. The wood is used for furniture and interior finish; sugar is sometimes made from the sap, and the inner bark possesses cathartic properties. In Colonial

# BUTTERFLY



PAINTED FOR THE NATIONAL ENCYCLOPEDIA BY MARY E. EATON

## NEOTROPICAL BUTTERFLIES

1. Cloudless Sulphur (*Catopsilia enbule*), common in the southern states and migrating in the fall as far north as Canada. 2. Pearly Melachite (*Victorina steneles*), found occasionally in Florida and commonly in the American tropics. 3. Delila (*Colanis delila*), a quite common Florida species. 4. Little Sulphur (*Terias lisa*), abundant in the American tropics and found as far north as Canada.

5. Genoveva (*Junonia genoveva*), found sparingly in Florida and commonly in the American tropics. 6. Pelaus (*Papilio pelaus*), a West Indian species. 7. Polydamas (*Papilio polydamas*), found sparingly in Florida and commonly in the American tropics. 8. Pearly Melachite (Fig. 2), underside. The Pearly Melachite is a member of a small species; its color pattern varies geographically.

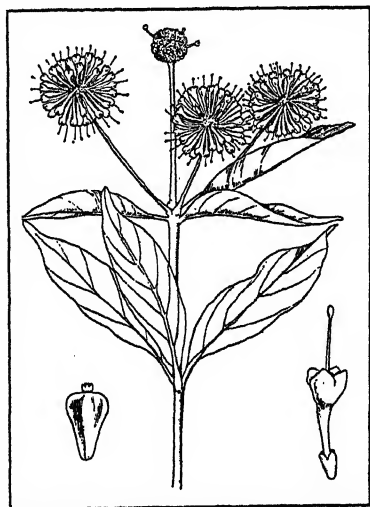




times the green husks of the nuts were used for dyeing homespun fabrics yellow, whence the name "butternut jeans" of pioneer days. In the tropics the oily, hard-shelled seeds of various species of *Caryocar* are called butternut.

**BUTTERWORT** (*Pinguicula vulgaris*), a small, stemless, insectivorous plant of the bladderwort family, called also bog violet. It grows on wet rocks and in gravelly places around the arctic circle and southward to the northern United States, central Europe and Asia. Oblong leaves are borne in a basal rosette from which rises a slender stalk terminating in a single, violet-purple, long-spurred flower. The leaves are covered with a sticky fluid in which small insects are caught. Stimulated by their presence the margins of the leaves roll inward and enclose them. Glands on the surface, which secrete a ferment, digest and absorb the prey, after which the leaves unroll. See also INSECTIVOROUS PLANTS.

**BUTTON-BUSH** (*Cephalanthus occidentalis*), a woody North American plant of the madder family, growing in swamps widely throughout the United States and southern Canada, and sparingly cultivated



FROM JEPSON, MAN. FL. PLANTS CALIF.. COPYRIGHT

BUTTON-BUSH

Fruit, flowering branchlet and flower

as an ornamental. In the northern states it grows as a shrub, but in Arkansas and eastern Texas it becomes a tree sometimes 40 ft. high. It bears smooth, entire, pointed leaves and dense heads of white flowers.

**BUTTRESS**, a mass of masonry used to strengthen a wall or pier, or to prevent its overturn by some side-acting force, such as wind pressure or the outward thrust of an arch or vault. In the early arched and vaulted structures of Mesopotamia and Egypt, as well as in most arched buildings in China, the vault and arch thrusts were withstood by the brute bulk and thickness of masonry. With the Roman development of cross or intersecting vaults of large size, the concentrated thrusts necessitated the use of large buttresses, really pieces of cross walls. In Romanesque

work the buttresses were first hardly more than decorative slightly projecting strips. Later engaged columns were used, and later still buttresses of bold projection, rectangular in plan, and topped with a simple sloped plane to throw off the water. In the Gothic period more complicated developments of the same type were made, often capped with decorated gables and pinnacles, which by increasing the weight increased the efficiency of the buttress. These, with FLYING BUTTRESSES that took the thrust of the high nave vaults, constituted one of the most important elements in Gothic exterior design. The structural buttress forms thus developed were taken over into decorative design, and ornamented many choir screens, choir stalls and even wooden chests and other furniture, especially in the 15th and 16th centuries.

Due to the prevalence of skeleton construction in large modern buildings, and the almost total lack of masonry vaults, buttress design plays only a small part in modern architecture. Buttresses occur at times to strengthen long unbroken masonry walls, and are frequent in retaining walls and such purely utilitarian structures. They are usually treated with extreme simplicity.

**BUTYL ACETATE**, a colorless liquid, having a strong odor; it will dissolve in organic solvents, but is only slightly soluble in water. It has the chemical formula  $\text{CH}_3\text{COOC}_4\text{H}_9$ , its specific gravity is 0.882, and it boils at 126.5° C.

It is produced from normal BUTYL ALCOHOL and acetic acid in the presence of a small amount of sulphuric acid which acts as the catalyst. Instead of acetic acid, calcium acetate may be used in the conversion kettle, in which case sufficient additional sulphuric acid must be present to set free the acetic acid from the lime salt. The mixture is fractionally distilled, so that water is continuously removed as formed in the reaction. The crude butyl acetate is distilled from the kettle and neutralized to remove the last traces of free acetic acid. It is then purified by redistillation. The ordinary commercial material contains about 92% of normal butyl acetate and 8% of normal butyl alcohol. The chief use for this product is in the nitrocellulose industry where it is used as a high boiling solvent for NITROCELLULOSE in the manufacture of LACQUERS, films, airplane dopes and artificial leather and patent leather dopes.

While cheaper and lower boiling materials are excellent solvents for nitrocellulose, a considerable proportion of high boiling products, such as normal butyl alcohol and normal butyl acetate, must also be used, so that the lacquer or dope will have a satisfactory flow, a good finish and will not blush. Blushing is caused by the condensation of atmospheric moisture on the finish, due to the rapid evaporation of the low boiling solvents. Secondary butyl acetate and isobutyl acetate are prepared similarly to normal butyl acetate. Secondary butyl acetate is also made by treating di-butyl sulphate with acetate of lime. C. L. G.

**BUTYL ALCOHOL**, a colorless liquid (also called butanol) which is miscible in all proportions

with most of the organic solvents, including ether, alcohol, chloroform, acetone, benzol and the various alkyl esters of organic acids. The physical characteristics of normal butyl alcohol are: freezing point,  $89^{\circ}$  C. approximately; boiling point,  $117.6^{\circ}$  C. at 760 mm.; flash point,  $35^{\circ}$  C.; critical temperature,  $287^{\circ}$  C.

Normal butyl alcohol is produced chiefly by the fermentation of materials containing carbohydrate. For each two parts of normal butyl alcohol obtained, about one part of ACETONE and a small proportion of ethyl alcohol (*see* ETHANOL) are simultaneously pro-

The chief use for normal butyl alcohol is in the NITROCELLULOSE LACQUER industry where it is used both as the alcohol and in the form of butyl acetate, butyl propionate and butyl lactate. It is also used as a solvent for gums and resins, and is an excellent blending agent, as the addition of a small amount will make many non-miscible liquids perfectly miscible.

Normal butyl alcohol is used as the starting point for the synthesis of butyraldehyde and the butyl amines, dibutyl phthalate, butyl acetate, butyl lactate, dibutyl tartrate, the butyl ether of ethylene glycol and numerous other products. Mention should be made of its isomers, the isobutyl, secondary butyl and tertiary butyl alcohols.

Isobutyl alcohol is present in fusel oil and is produced along with methyl, ethyl, propyl and higher alcohols by subjecting carbon monoxide and hydrogen to elevated temperatures and pressures in the presence of catalysts. The secondary and tertiary butyl alcohols are produced by absorbing the respective butylenes in sulphuric acid and hydrolyzing the dibutyl sulphates.

C. L. G.

**BUTYRIC ACID**, a fatty acid ( $C_3H_7\cdot CO_2H$ ), present in butter as an ester of glycerine. It also occurs in the parsnip, meat juice, perspiration, and excrementa. It is soluble in water, has an unpleasant odor, boils at  $163^{\circ}$  C., and solidifies at  $-19^{\circ}$  C.

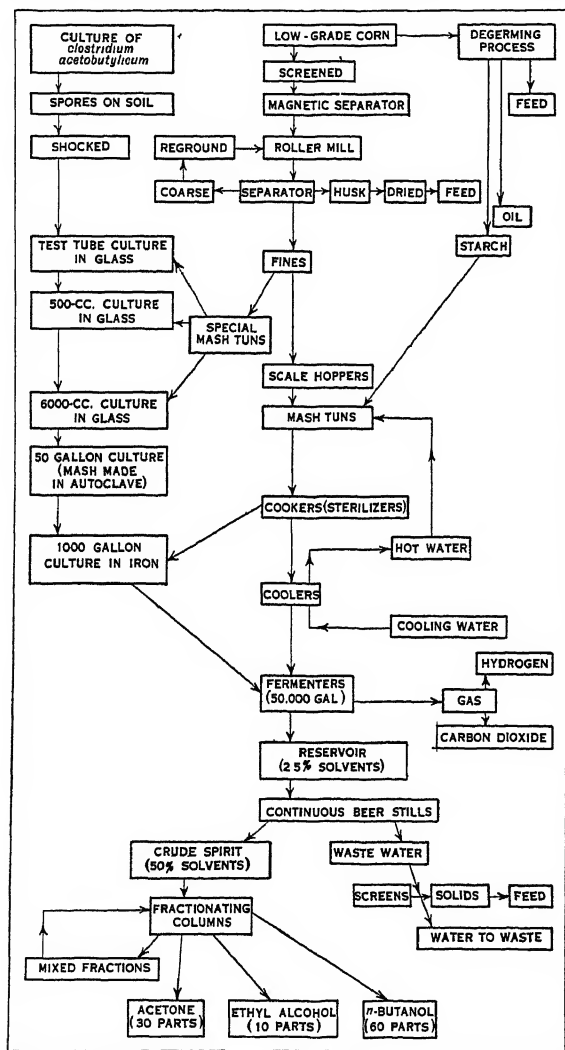
**BUYER**, one who buys merchandise for resale. A buyer for a retail house whose merchandise has fashion elements, e.g., women's wear, must have a keen sense of style to forecast public taste. Sometimes he is advised by a **STYLIST** as to the best fashions. The buyer holds a key position in department stores, since he must strike a profitable balance between inventory, demand and seasonal influences. He must have trading ability to secure a maximum quality at minimum prices and place his employers in a strong competitive position.

**BUYER'S OPTION**, a contract between the purchaser and vendor of securities which affords the purchaser the privilege of refusing delivery until a certain date, at the same time permitting him to request delivery at a day's notice. Ordinarily the vendor receives interest as long as he holds the security.

**BUYS BALLOT'S LAW**, one of the fundamental laws of meteorology, stating that under the influence of the rotation of the earth a wind blowing from a region of high pressure to one of lower pressure, is deflected toward the left on the northern hemisphere, to the right on the southern hemisphere.

**BUZAU (BUZEU)**, capital of the Rumanian district and on the river of the same name, at the edge of the Carpathian Mountains. It is seat of a Greek Orthodox bishop. The most important commercial products are crude oil, lumber and grains. Pop. 1930, 36,115.

**BUZZARD**, a name given to various birds of prey, especially to numerous hawks with broad short wings and rather slow flight. The common buzzard of Europe (*Buteo vulgaris*), nearly two feet in length, with brown plumage streaked and barred with lighter



COURTESY, INDUSTRIAL AND ENGINEERING CHEMISTRY

FLOW SHEET SHOWING THE PRODUCTION OF NORMAL BUTYL ALCOHOL BY THE FERMENTATION OF CORN

duced. The fermented mash is distilled and the various ingredients are thus obtained in pure form. Normal butyl alcohol is also produced by synthetic means from ethyl alcohol or acetylene with acetaldehyde, aldol and crotonaldehyde as the intermediate products.

## BYZANTINE ARCHITECTURE



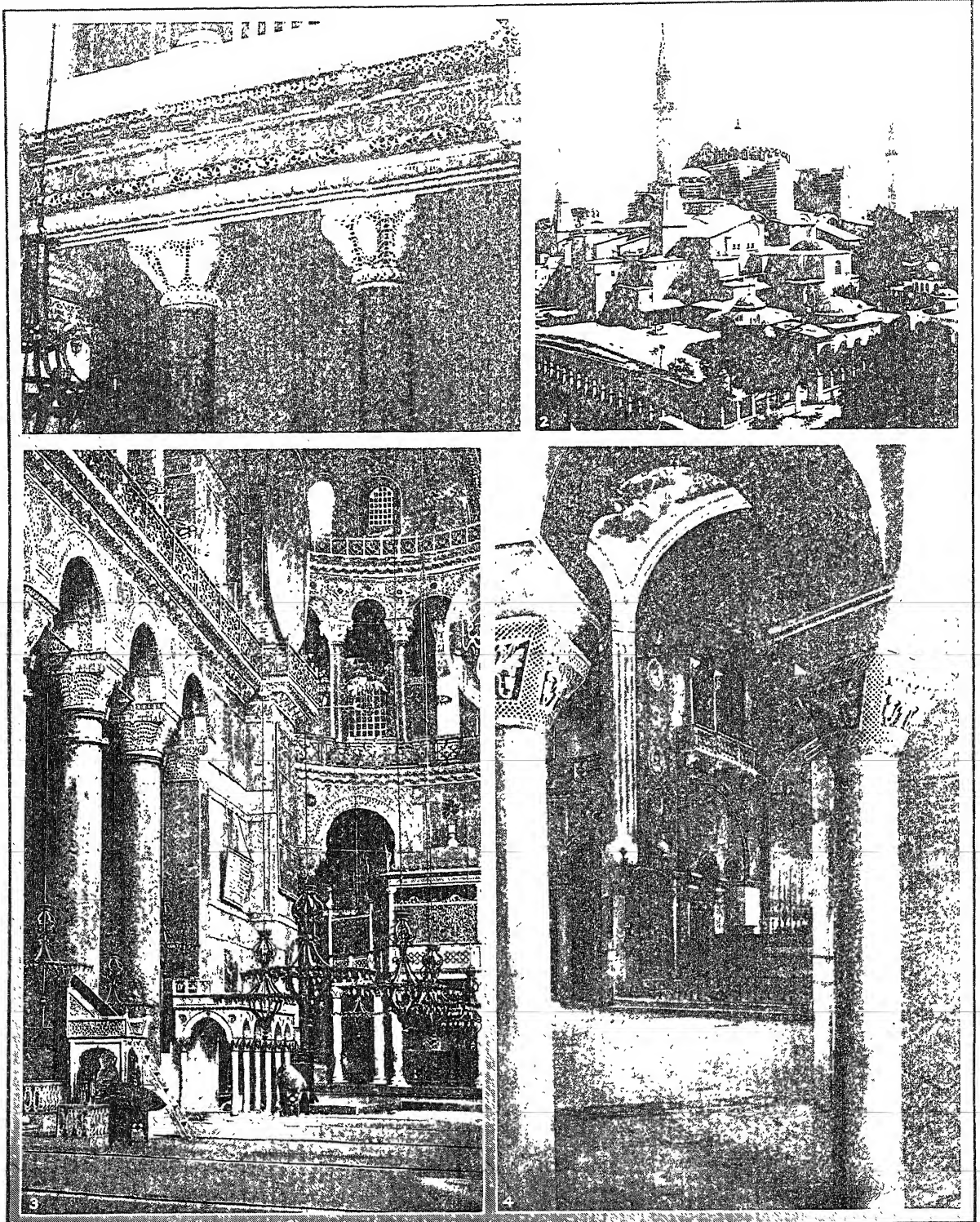
1, 2. COURTESY WARE MEMORIAL LIBRARY, COLUMBIA UNIVERSITY; 3. PHOTO BY DE COU, FROM EWING GALLOWAY; 4. PUBLISHERS' PHOTO SERVICE

### BYZANTINE CHURCHES OF TURKEY, GREECE, RUSSIA AND ITALY

1. Fetiye-Jami Mosque, formerly a Byzantine church, Constantinople. 2. Byzantine Church of St. Theodore, Athens. 3. Church of St. Basil, Moscow, built from 1554 to 1560,

now a Soviet museum. 4. East end of the Church of St. Mark, Venice, showing the pulpit and choir screen. Behind can be seen the apse mosaics.

## BYZANTINE ARCHITECTURE



1, 3, 4, COURTESY WARE MEMORIAL LIBRARY, COLUMBIA UNIVERSITY

### LEADING BYZANTINE CHURCHES OF EUROPE

1. Columns supporting the entablature of the Church of Saints Sergius and Bacchus, Constantinople. 535. 2. Church of St. Sophia, Constantinople. 532-538. 3. In-

terior of the Church of St. Sophia. 4. Vaulted and pilared interior of the Church of San Vitale, Ravenna, Italy, begun about 526 and dedicated in 547.



## BYZANTINE ART

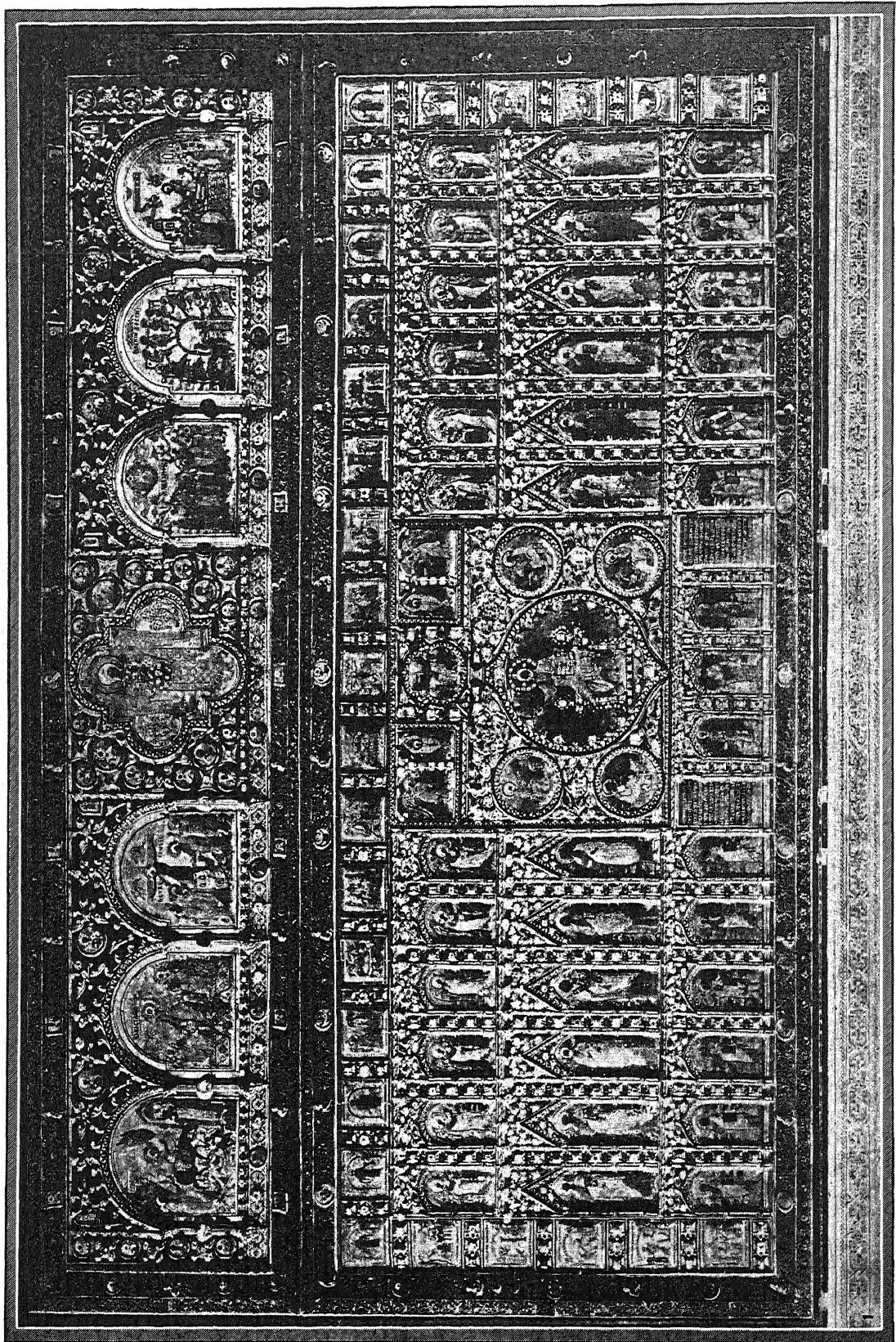


1, 2, COURTESY METROPOLITAN MUSEUM OF ART

### BYZANTINE ART AND DECORATION

1. Ivory figure of the Virgin and Child cut from a plaque. 10th-11th centuries. 2. Ivory casket decorated with mythological scenes in relief. 9th-10th centuries. 3. Baptistery of San Giovanni in Fonte, Ravenna, Italy, dating from the

5th century, showing the mosaic decoration of the interior. 4. Head of St. Mark done in enamels, a book cover in the Treasury, Church of St. Mark, Venice. 10th-11th centuries. The white marble font is of the 16th century.



A BYZANTINE ALTARPIECE

The Pala d'Oro, an enameled altarpiece in St. Mark's Cathedral, Venice. The gold and silver panels are studded with jewels.  
This work was executed by goldsmiths in Constantinople about 1105.

and darker markings, breeds from the Azores almost to the Arctic Circle. It nests on cliffs and in trees, laying 3 or 4 whitish eggs blotched with brown; it feeds chiefly on field-mice and other small animals and is not destructive to poultry or game. In North America the species most closely related to the European buzzard are commonly called hawks, as the red-tailed hawk (*B. borealis*) and the red-shouldered hawk (*B. lineatus*), of the eastern United States and Canada, and the western red-tailed hawk (*B. borealis calurus*) and Swainson's hawk (*B. swainsoni*), found mostly west of the Mississippi. All large hawks feed almost entirely upon animals injurious to crops and are therefore beneficial to agriculture. In the South the turkey and black vultures are commonly called buzzards. *See also* HAWK; TURKEY VULTURE.

**BYDGOSZCZ.** *See* BROMBERG.

**BYNG, SIR JULIAN** (1862- ), British general, was born Sept. 11, 1862. He joined the 10th Hussars in 1883, served in the Sudan expedition in 1884, and in the Boer War in 1899-1902. He was appointed a major-general in 1909, and was placed in command of the army of occupation in Egypt in 1912. He commanded the 3rd Cavalry division in France in 1914, commanded the IX army in the Dardanelles in 1915, and returned to France in 1916 to command the Canadian forces on the western front. He captured Vimy Ridge in 1917, held it against repeated attacks, and was the first to use tanks on a large scale, winning a signal victory at Cambrai in Nov. 1917. (*See* WORLD WAR.) In Aug. 1918, he made a successful drive from the old Somme front. After the war he received a barony and a gift of £30,000 from the crown. In 1921-26 he was governor-general of Canada, and in 1926 was made a viscount. In 1928 he became the commissioner of police in London.

**BY-PASS CONDENSER**, a CONDENSER placed in an electrical circuit so as to afford an easy path to alternating current and thereby prevent the flow of the current in some other part of the circuit.

**BYRD, RICHARD EVELYN** (1888- ), American Arctic and Antarctic explorer, was born Oct. 25, 1888, at Winchester, Va. He graduated from the U.S. Naval Academy, Annapolis, Md., in 1912, and during the World War was in charge of U.S. naval forces in Canada. He was promoted by Congress in 1922 to the rank of lieutenant-commander. Prior to the World War he was interested in aviation, and when the War was over, he became an experienced flyer and navigator.

In 1925, Byrd joined the MacMillan expedition to Greenland, having command of the aviation unit. The following year, accompanied by Floyd Bennett, he took off from King's Bay, Spitzbergen, on May 9th, and made the first airplane flight to the North Pole and back, in 15½ hours, covering a distance of 1600 miles. From June 29 to July 1, 1927, Byrd in a similar tri-motored monoplane flew with three companions from New York to Ver-sur-Mer, France, failing to locate his objective, Paris, in the fog and rain.

After many months' preparation, he organized an Antarctic expedition, equipped with the latest devices and apparatus (including motion picture cameras) for making extensive studies of the Antarctic regions. He set sail in the City of New York from New York, on Aug. 25, 1928, establishing in January of the following year a base at Little America, Antarctic. With 41 companions, he lived 14 months on the Antarctic continent. Besides a flight to the South Pole, on Nov. 29, 1929, the Byrd expedition discovered and mapped 200,000 sq. mi. of territory, and obtained important geographical and geological data. After his North Pole flight, Byrd published an account of his experiences in a volume entitled *Skyward*. He related the story of his stay in the Antarctic in a second book, *Little America*. In recognition of the South Polar flight, Congress advanced him to the rank of rear-admiral. He has been awarded the Hubbard gold medal, Congressional Medal of Honor, Distinguished Service Medal, Flying Cross, and is a member of the French Legion of Honor.

**BYRD, WILLIAM** (c. 1542-1623), English music composer, was born about 1542, probably at Lincoln. He was one of the important Elizabethan composers, and, in token of Queen Elizabeth's admiration, was granted a monopoly on music printing with Thomas Tallis. He is noted chiefly for his madrigals and for the collection entitled *Psalmes, Sonets, and Songs of Sadnes and Pietie, made into Musicke of five parts*. Byrd was an accomplished organist. He died July 4, 1623.

**BYRD, WILLIAM** (1674-1744), American author, was born at Westover, Va., Mar. 28, 1674. He was educated in England and, returning to America, rose to influential position in the Colonies where he eventually became president of the King's Council. In 1733 he founded Richmond, Va. Byrd was a member of the board of commissioners on the North Carolina boundary, and promoted immigration to America. Possessing one of the finest libraries in the New World, Byrd also was a patron of the arts and sciences. His *Westover Manuscripts* have been widely read. He died Aug. 26, 1744.

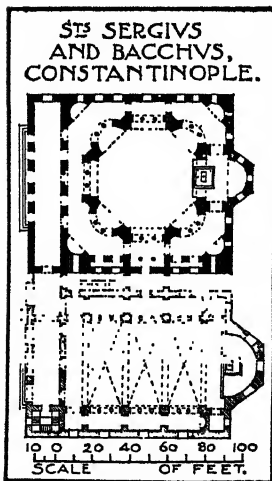
**BYRON, GEORGE GORDON, LORD** (1788-1824), English poet, was born in London, Jan. 22, 1788. His father was profligate, and his mother, after leaving her husband, treated her son with alternate fondness and unkindness. His childhood was passed in poverty, but in early youth he came into a title and a large estate. He was educated at Harrow and Cambridge, and while there issued a volume which, revised, appeared in 1807 as *Hours of Idleness*. Brougham attacked the book in the *Edinburgh Review*, and Byron's response was the devastating *English Bards and Scotch Reviewers*. After letting fly this barbed arrow he went abroad and on his return in 1812 brought out the first two cantos of *CHILDE HAROLD*. Almost in a day he became a famous poet and a social lion. Though the career thus brilliantly opened was marred by personal excesses, Byron remained faithful to poetic production.



In 1815 the poet married Miss Milbanke; after about a year, however, Lady Byron returned to her father's home, and Byron left England. The third canto of *Childe Harold* was finished at Venice. The witty *Beppo* appeared, and *DON JUAN* was begun in 1818. This, his principal work, and *The Vision of Judgment* occupied his last period of creative activity. The close of Byron's career atones for much; he gave his life to the cause of Greek freedom. His work lacks spiritual impulse, but possesses fire, music, imagination. He died of fever and exposure at Missolonghi, Greece, Apr. 19, 1824. See also ENGLISH LITERATURE.

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**BYZANTINE ARCHITECTURE**, the style developed in the eastern Roman Empire after the removal of the capital from Rome to Constantinople (Byzantium). It was primarily a development due to the blend of eastern decorative ideas and building types with Roman structural skill. Its creation and high development reflected the increased importance of the East symbolized in Constantine's change of capital. Byzantine architecture was principally developed in church buildings, and its first great contribution was the use of the dome on pendentives.



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PLAN OF THE CHURCH OF SAINTS SERGIUS AND BACCHUS, CONSTANTINOPLE

or projecting courses, of masonry in the corners, diagonal arches and other construction. The filling of the corners of a square hall with pendentives, that is segments of a sphere such that the intersections gave arches on the sides and a circle at the top on which a dome could be built, was, however, a Byzantine achievement, and opened the way for the typical Byzantine church interiors. Intermediate Roman types closely approximating the pendentive can be seen in the 3rd century Baths of Caracalla in Rome, and in the 5th century San Giovanni in Fonte, at Ravenna.

Byzantine architecture was Roman in its use of cheap structural materials with a rich decorative facing, consisting of marble panels with color above, but Eastern in the carving which decorated column capitals and moldings, these being flat, full of deeply incised lines and holes, and lace-like in effect. It shows the eastern love of surface ornament instead of the Roman love of full changing, rounded relief. The Byzantine designers placed all the emphasis on the interior of a building; exteriors were largely unstudied until a late period.

**Origins, Early Influences and Sources.** As early as the reign of Hadrian a type of ornament was developing in Syria which was markedly different from that of Rome itself and which constituted the first great source of Byzantine architecture. Syrian carvers, using a hard stone, sought to obtain effects by cutting many deep holes, leaving the ornament in a single plane. In the palace of Diocletian at Spalato, 303, this influence towards flatness and intricate lace-like effects can be clearly seen. By the 6th century it dominated all Byzantine work, necessitating an abandonment of the typical Roman acanthus leaf, flattening all the classic moldings, and using a capital of simple, almost geometrical form, with rich surface carving, in place of the favorite Roman Corinthian capital. Another characteristic Byzantine detail was the impost block, or pulvino, a truncated pyramid with the small end down, used between the column and the arches or vaults which it supported.

The second great source of Byzantine forms and ideals was the love of the Syrian and Mesopotamian builders for round, polygonal, square, or Greek cross plans, instead of the rectangle more popular in Europe, typified by churches at Ezra and Bosra, and the enormous 5th century cross-shaped group of St. Simeon Stylites Kalaat Simaan, in which the central area was an open court. This influence came to Constantinople probably by way of Armenia, which developed at an early date a high level of culture and architectural achievement. The whole question of the earlier Christian architecture of Syria, Mesopotamia, Iran and Armenia needs further research; but its influence on Byzantine architecture is unquestionable, and one reason for the rapid deviation of the style from Roman forms.

The third great source of Byzantine influence was in the magnificent building tradition of Imperial Rome, whose later architects had developed great skill in the design of vaulted buildings and the construction of light concrete and brick vaults. The Romans understood well the principle of the intersecting or groined vault, and the use of few and large supports to carry concentrated loads and resist concentrated vault thrusts. In the 4th century they had begun to use columns to carry round arches instead of a flat entablature as in the court of the Palace of Diocletian at Spalatro. They had developed a superb technique in marble sheathing and a rich color sense. The Byzantine architects adopted all of this, and carried the ideas still further, abandoning the entablature

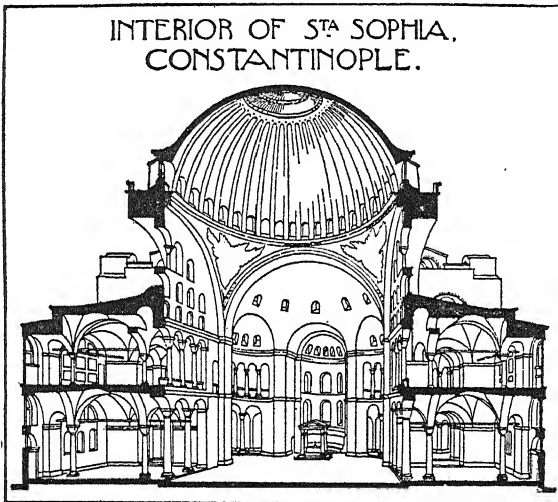
when arches were used, and through the development of the pendentive, creating new problems for the Roman planning skill. But the general plan theories underlying the Basilica of Maxentius and Constantine in Rome, and those of the church of St. Sophia in Constantinople are identical.

**Early Byzantine Architecture.** The earliest existing church using complete spherical pendentives seems to be St. Sophia at Salonika, Greece, completed 495; but pendentives had been used as early as 440 in the mausoleum of Galla Placidia in Ravenna, where they are continuous in curvature with the dome. In both of these early examples mosaic decoration for the dome and upper portions was already present. In the Ravenna mausoleum the mosaics are classic in style, on a dark blue ground, while in the Salonika church the Byzantine type on a rich gold ground is found.

All of these new forces received a supreme expression in the great Constantinople church of the Divine Wisdom, St. Sophia, built by Justinian. Begun in

of the dome, giving an incredibly light effect. There was a narthex or porch across the whole width of the front, and originally an atrium or arcaded court in front of that. Heights and sizes are so arranged that the moment one enters the main door, the eye can see clear to the top of the central dome; the whole interior is at once apparent.

Decoratively, the whole was originally as superb as its construction was daring. The piers and walls are sheathed in large panels of rich variegated marbles, and the columns are also of colored, polished porphyry and marble. Capitals and spandrels are lace-like and delicate. Above the level of the arch-spring the vaults,

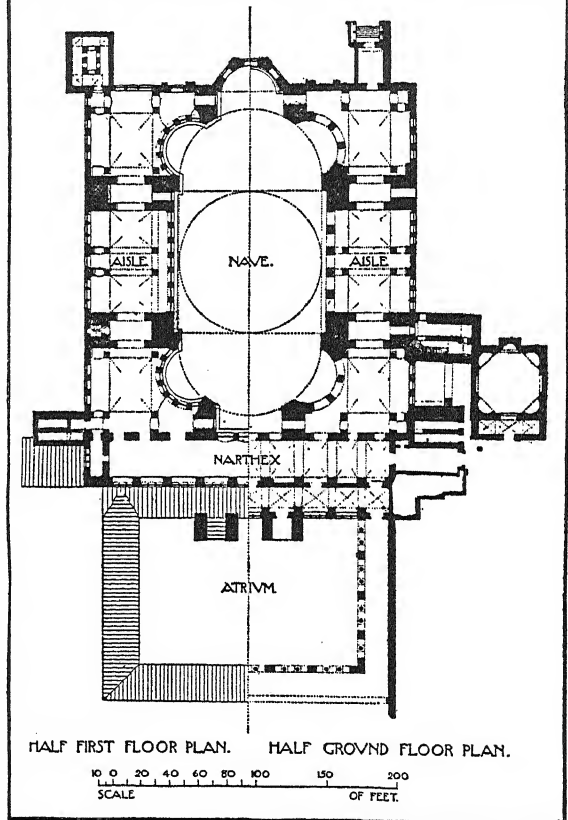


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INTERIOR OF THE CHURCH OF ST. SOPHIA, CONSTANTINOPLE

532, it was completed by 537, but the dome fell and had to be reconstructed in 558. The architects of the church were Anthemios of Tralles and Isidoros of Miletus. St. Sophia is rectangular in general mass. Its central dome of 100 feet span is supported on four enormous arches, two of which, on the sides, are filled with screen walls pierced by rows of windows. The other two open into great half domes, which in turn open into smaller diagonal domed niches. The walls at the sides are supported on two stages of arcade opening into side aisles which pierce the great piers by means of arches; the upper side aisle was the women's gallery. These irregular aisles are roofed by ingenious combinations of domical and intersecting vaults. The interior is lighted not only by the clerestory windows in the walls over the aisles, but also by a ring of windows pierced through the base

SANTA SOPHIA, CONSTANTINOPLE.



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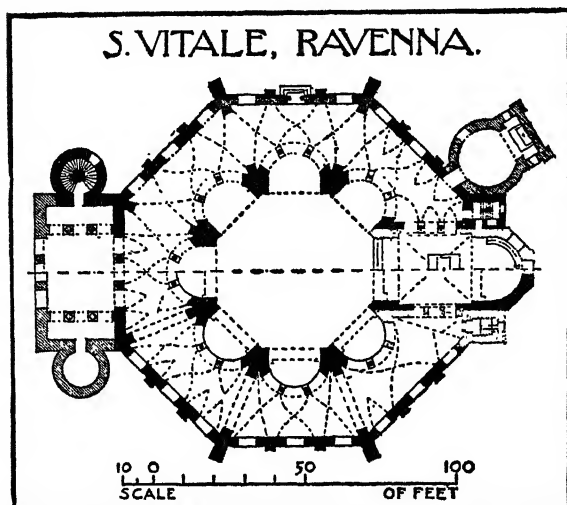
CHURCH OF ST. SOPHIA, CONSTANTINOPLE

arches and walls are completely covered with glass mosaic, now mostly hidden by plaster put on by the Turks to hide the idols some time after the church had been transformed into a mosque. The pendentives have the six-winged cherubim; saints were ranged between the windows, and rich patterns of distinctly oriental type, probably based on textiles, were used on the vault surfaces. The whole ground of the mosaic was gold.

Contemporary with St. Sophia is the Church of San Vitale in Ravenna, 526-547, in the Italian exarchate,



Smaller, less daring and consistent in its architecture, its decorative carving and rich choir mosaics are typically Byzantine. Two other churches in Ravenna of the 6th century, San Apollinare in Classe and San Apollinare Nuovo, reveal the mixture of Roman and Byzantine elements current in that part of Italy. The



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PLAN OF THE CHURCH OF SAN VITALE, RAVENNA, ITALY

conception, basilican plan and construction are Roman; the mosaic decoration Byzantine in type. Other interesting early Byzantine monuments appear in Salonika, such as the 4th century round church of St. George, entirely Roman in type, and the basilican churches known as Eski; Djami, early 5th century, and St. Dametrios, early 6th century; and a varied form, Byzantine in detail only, in the Coptic churches of Egypt.

**Later Developments.** The use of windows in the base of a dome, as in St. Sophia and San Vitale, naturally suggested the imposition of a stage of vertical wall in which they could be easily built, between the top of the pendentives and the bottom of the dome itself. This cylindrical wall is called a drum, and during the later Byzantine work it became more and more important. It apparently was first used in the rebuilt portions of St. Irene at Constantinople. In Greece and the Balkans, the drum tended to become higher and higher, and the dome itself smaller and smaller as time went on. At the same time there was a growing interest in exterior treatment.

The outside of St. Sophia was allowed to grow as it pleased; there was little attempt at decoration. Later, however, vertical wall pilaster strips or buttress strips were used to break up wall surfaces, arched cornices were used, and the drum made decorative with engaged columns. Banding of the exterior by alternating a course of stone with two or three courses of brick was used as a decorative medium, and in Greece at least, the sheathing of the exterior with marble panels as in the 9th century church at Athens known

as the Little Cathedral. The 12th century Church of the Chora in Constantinople, known as Kahriyeh Djami, with its lovely mosaics of 1303, high drums and small scale, is typical of this later work. The rich exterior of St. Theodore in Constantinople, 12th century, and the churches of St. Theodore in Athens, 1049, and of the monasteries of Daphni, Greece, about 1100, and St. Luke's, Stiris, Greece, 12th century, are also characteristic examples.

**Civil and Domestic Architecture.** Few remnants of Byzantine domestic architecture remain exposed except those of the local schools of Syria and Venice. The sea facade of the so-called Palace of Justinian, or of the Hebdomon, in Constantinople, shows features not unlike those of the Palace of Diocletian at Spalatro: many large openings towards the sea, and detail generally classic in type. All the larger rooms and halls were vaulted with barrel and intersecting vaults; the dome seems to have been reserved for religious use. The much later remains of a palace hall near the land walls of Constantinople, known as Tekfur Serai, show large windows, exterior polychrome masonry in interesting patterns, and projecting balconies. The building originally had three stories, the lowest vaulted, the other two with flat timber ceilings. Descriptions of the Byzantine palaces picture interiors lavish with sheathed marble and glass mosaic much in the style of church work. A mosaic in Ravenna showing the front of the Palace of Theodoros gives a good idea of the exterior of a Byzantine palace. There likewise exist in Constantinople certain Byzantine buildings that may have been monastic, such as Sajakdar Mesjid, an octagonal building that, like the octagonal building near the church of the Pantokrator, may have been a monastic library. There is also a long building, originally timber roofed, with an apse, at first sight basilican in type but without side aisles, that was probably the 9th century Rectory of the Monastery of Manuel.

Many of the stone built villages of the Hauran, in Syria, remain in remarkable preservation, and contain hundreds of houses of the period from the 5th to the 7th centuries. In general they were built around a court, had two stories of colonnades on one or more of the court sides, and show tremendous ingenuity in their use of stone as a building material to minimize the use of wood. The ornament is of a peculiar, flat and original type, characteristic of Syria alone and unlike either Roman or Constantinopolitan work. These buildings are best illustrated in de Vogüé's *Syrie Centrale*.

The Byzantine palaces of Venice are interesting in their application of paneled marble sheathing to exterior design, and their development of grouped arched windows with colonnettes between, and with a rectangular molded frame around the entire group. Built often on narrow lots, they consist usually of a simple rectangular block between party walls; there is often a court to the rear enclosing a circular staircase. Floor construction is always of wood. The famous walls and gates of Constantinople reveal

Byzantine skill in military architecture and the continuing persistence of late Roman tradition. The system employed of a moat with two lines of walls, the rear line being higher and strengthened by periodic square towers, had been originally developed for fortified camps by the Romans. Its construction is, however, Byzantine in type.

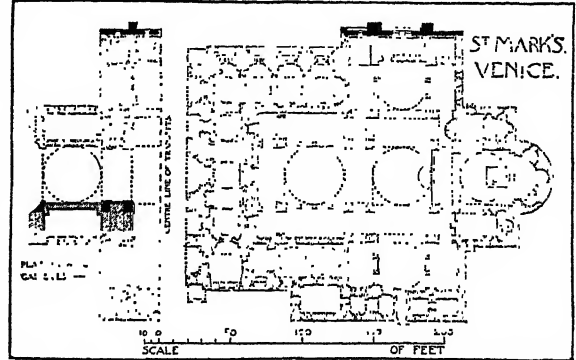
**Outside of Constantinople and Greece.** In Armenia a variant type of domed church with barrel vaulted nave and transepts gave rise to an almost entirely different style. Cut stone was the material used, and richness was therefore sought in architectural, carved detail, rather than in marble sheathing and mosaic. Carved moldings, interlacing patterns, decorative arcading, great crosses, all-over designs are all found on exterior wall surfaces, used with great exuberance. Interiors were monumental and rather cold. The greatest monuments are in the ruined city of Ani, principally of the 10th century.

Small scale and a growing exterior richness characterized the later Byzantine work in the Balkans. Wall arcading, sometimes accented by painting, was much used, and wooden galleries frequently surrounded the churches. The style developed gradually and with greater and more fantastic richness until well into the 17th and even to the 18th centuries, when Baroque motives from western Europe crept in, and at last overwhelmed the earlier tradition.

The architecture of Christian Russia up to the time of Peter the Great was also dominantly Byzantine. Painting was usually used instead of mosaics for interior decoration, and the lace-like carving of Byzantine capitals and bands yielded to simple cushion and molded forms. Capitals were unimportant, and there was a frequent use of little columns molded like balusters. On the exterior, covering domes of onion shape became more and more common, and often, in the later examples, the central part was built up into an elaborate kind of spire, decorated with range after range of small projecting arched semicircular forms almost like shells. This movement reached a climax in the 17th century. Typical monuments are the Dessiatinnaya Church, 991, and the Cathedral of St. Sophia, 1017, both at Kiev; the Church of the Intercession of the Holy Virgin, 1165, near Vladimir; and the 17th century Cathedral of St. Basil at Moscow, typical of the later works.

The most interesting of the local offshoots of Byzantine is the Venetian school. Venice, through its commerce and its Dalmatian possessions, was always in close touch with the eastern empire. The builders of St. Mark's, begun in 978, and completed on a different scheme in 1063, naturally turned to Constantinople for models, and took the great church of the Holy Apostles, built in the 6th century but no longer existing, as their inspiration. In general interior effect St. Mark's, with its five great mosaiced domes, its simple structural forms and its rich marble facings and floor, gives perhaps a clearer impression of what the Byzantine designers were striving for than any other building. In detail, however, there were many

departures from the Byzantine ideal, particularly in the carving, where not only was the Roman influence strong, as in the use of unusually correct Corinthian capitals for columns, but also there was a great use of full, rounded relief, and of naturalistic animal and vegetable forms. The exterior preserves little of its



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original effect, save in the columns of the entrances and the marble sheathing of the walls. The entire upper part, including the high pointed domes, is a later and Gothic addition.

Many dominantly Byzantine traits also appear in medieval decoration in Sicily, where an architectural style of mixed Arabic, Romanesque and Byzantine elements was developed. In decorative idea, the Byzantine influence is supreme, and the rich color decoration of marble sheathing, gold ground mosaic, and painting, to be seen in Monreale Cathedral, 12th century, or the Capella Palatina in Palermo, is typically Byzantine in effect.

**The Influence of Byzantine Architecture.** The influence exerted by Byzantine work on other contemporary and succeeding styles was enormous. It was broadcast not only by traveling Greek and Byzantine decorators and workmen, but also through a large and lively commerce in Byzantine textiles, carved ivories, jewelry and enamels. The exquisite mosaics of the Roman Basilicas were Byzantine in decorative conception and technique, and frequently the work of Greek artisans. Occasionally there seems direct copying of building types. Thus Charlemagne's church at Aachen, early 9th century, is modeled on San Vitale at Ravenna, and the church of St. Front at Perigueux, early 12th century, on St. Mark's at Venice. Byzantine influence is especially noticeable in South French and South Italian Romanesque work and in some Lombard ornament, and it controlled many schools of Mohammedan architecture, especially that of Turkey.

T. F. H.

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**BYZANTINE ART.** A rich decorative impulse flourished throughout the Byzantine Empire from the founding of Constantinople (Byzantium) in 330, to its capture by the Mohammedans in 1453. Its influence spread to Italy and other countries during the Middle Ages, and it is still the dominant style wherever the Greek Orthodox religion prevails. Linking East and West, this art represented the union of three elements: Christianity, Hellenism and Orientalism. From the first it received its subject material; from the second, a power of imagination; and from the third, a passion for brilliant color and ornamentation.

Byzantine art falls into four main periods:

1. The formative period, from the founding of Constantinople to the outbreak of iconoclasm (330-726).

2. The Iconoclastic period (726-842), characterized by strict proscriptions against images, and the wanton destruction of many works of art by the iconoclasts or idol-breakers. During this time a large number of sculptors, mosaicists and other art workers left the Eastern Empire and traveled to foreign lands, spreading the Byzantine influence.

3. The Macedonian and Comnenian period (842-1204), marked by an artistic renaissance rich in splendor.

4. The period of the Palaeologi, from the Restoration to the Turkish Conquest, in 1453, during which a gradual decline in art took place.

The outstanding contribution of Byzantine art is to be found in the magnificent mosaics that covered the walls and domes of principal buildings, forming their chief decorative feature. Church interiors were profusely ornamented with series of mosaics, executed in small colored marbles or glasses, and depicting stories taken mainly from the Bible. Such mosaics added greatly to the splendor of that finest architectural achievement of the Byzantines, the church of Hagia Sophia at Constantinople. Decorating the walls of S. Vitale at Ravenna are two mosaics of importance: one pictures the Emperor Justinian attended by prelates and courtiers in poses somewhat stiff and uniform, all sumptuously arrayed; the other represents his wife, Theodora, surrounded by her court ladies, also resplendent in gorgeous costumes.

Besides mosaics, wall painting was also an important form of surface decoration, especially during the early Christian period. But the painter's art found its highest expression in the illumination of manuscripts. Among the magnificent remaining examples are the *Natural History* of Diocorides of Vienna, and the celebrated *Joshua Roll* at the Vatican.

Due largely to the religious prejudices against images, statuary art was practically non-existent among the Byzantines. Decorative sculpture, notably the capitals of columns, which display a variety of geometric, floral and animal designs, was mainly derived from Oriental models.

The Byzantines acquired a deserved fame for their carvings in ivory, executed on diptychs, triptychs, caskets, furniture, and other articles. The diptychs,

especially, show remarkably fine craftsmanship. Another highly developed art was that of the enameler. A beautiful example of Byzantine enamel-work remains in the famous altar-screen in St. Mark's at Venice. Textiles, consisting mainly of silk fabrics, formed an important branch of the minor arts. The richly ornamented costumes of the Byzantines show their taste for ostentatious luxury.

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**BYZANTINE EMPIRE.** No epochal event marks the change of the Roman Empire to the Byzantine, and a long period of continuity of government covers the gradual change in almost every feature of civilization. Even before Constantine established the capital of the Roman Empire at Constantinople in 330, little but the name was left that resembled the empire of the 1st century. In place of an *orbis terrarum* of municipalities had come a centralized monarchy where all power flowed from a divinely constituted emperor. The economic basis of the Empire was crumbling. In place of a complex money and slave economy had arisen barter and a servile system of land cultivation. The old classical religion of separate cults of local gods had disappeared before various religions of one great God. It was from the eastern Mediterranean that all these tendencies flowed, the east which had never been Romanized but only superficially tinted with a wash of classicism during the century preceding and the one following the birth of Christ. Gradually the old eastern provinces became the center of a quite new Empire, and the west, which had once been the center, was neglected. From the view of the west this process of converting the Roman Empire into a near eastern theocratic monarchy was the fall of Rome. To the east it was merely the natural assertion of an eastern way of life. When Constantine and his immediate successors during the 4th century elevated Christianity to supremacy over its competitors, the change was nearly complete, and the Byzantine Empire became the nation of the orthodox Christians of the east.

**Territorial Changes.** After the defeat of the Emperor Valens by the Visigoths at Adrianople in 378 the barbarians began the process of erecting in the western half of the Empire autonomous kingdoms wherein the bonds with Constantinople were easily broken. Lands effectively within the Empire were substantially confined to those east of the Adriatic which have come to be considered Byzantine or East Roman. For some time the western provinces defended themselves in spasmodic, local outbursts against the infiltration of the barbarians; but the authority of the Emperor at Constantinople was confined to Egypt, Syria, Asia Minor and the Balkan Peninsula. To the north and west were Germanic and Slavic barbarians. On the east was the powerful Empire of the Sassanids, a match for Byzantium in civilization and military power. In the 150 years

from the Battle of Adrianople to the reign of Justinian, the Empire defended these frontiers against further barbarian invasion.

**Justinian.** The Macedonian peasant who in 518 became the Emperor Justinian hailed from the last little corner of the Empire that spoke Latin. Feeling himself the heir of the Roman Caesars he failed to protect adequately his eastern frontier against the powerful Sassanid Empire in Persia and the Danubian frontier against Avars and Slavs, while he spent his strength in a series of exhausting wars to reconquer the lost provinces of the west. This proved to be a fatal policy. Italy, North Africa and a part of Spain were regained for a short time; but the west was never other than a drain upon Byzantine strength. The western provinces were soon lost; and within 50 years of Justinian's death the Sassanids had overrun all Syria and Egypt and the very existence of the Empire seemed in question. But under Justinian the Empire attained its greatest magnificence, and by him were accomplished two things of great significance, for the West as well as for the East. These were the building of the Church (now Mosque) of St. Sophia, and the codification of Roman law in the *CORPUS JURIS CIVILIS*. With great fidelity to detail he also introduced reforms in the administration at Constantinople. Into the religious debates of the time, which were disturbing the internal peace of the Empire, he entered with enthusiasm, priding himself upon his skill in theological discussion. His manifold activities, however, put a heavy strain upon the resources of the Empire; the net result of his reign was to weaken rather than strengthen the state.

The Emperor Heraclius drove out the Sassanids, in fact carried the victorious war to Ctesiphon, but he had hardly rested from his campaigns before an army of Arabs, inspired by the new religion preached by Mohammed, defeated the frontier garrisons and invaded Syria. The exhausted Empire had not sufficient troops to oppose them and the tide rolled on. Yet it is a mistake to speak of an Arab conquest. Syria and Egypt, torn with heresy and feeling bitterly the burden of taxation, turned easily to the relatively light rule of the Mohammedan invaders. Syria, Egypt and Africa were lost to the Empire; Asia Minor was repeatedly ravaged by the invader, but was not incorporated within the Arab state. Constantinople withstood an attack by land and sea from 673-678 and again during the years 717-718. With the repulse of the second siege the Empire obtained a breathing space, but it was a sadly shrunken country. Most of Italy was lost to the Lombards; in the north the Bulgarians had crossed the Danube, and in the east the Byzantine frontier never again passed the Tarsus Mts. Yet the Empire succeeded in renewing its strength under the iron emperors of the Isaurian Dynasty. The last vestiges of imperial rule in Italy and Sicily were blotted out; but the Bulgarians were held in check, and in the long bitter controversy of the Icons (*see* *ICONOCLASTS*), 726-842, the state maintained its ascendancy over the Church.

The state was threatened, however, by two internal dangers: the continued growth of an efficient but unwieldy bureaucracy, and the rise of a feudal landed aristocracy who by their internal feud operated as an unbalancing element in the body politic. These were checked, and the ever-present frontier danger was averted by a succession of powerful rulers who now mounted the throne.

**The Macedonian Dynasty, 867-1081.** The Macedonian dynasty marks the most brilliant period of Byzantine history. The rulers of this dynasty were strong, even though unscrupulous men. Basil I won the throne by a *coup d'état*. After him the throne was open to usurpers powerful enough to reach it, such men as Nicephorus Phocas and the Armenian, John Tzimiskis, great soldiers and powerful administrators. They strengthened their eastern frontier, and pressed their conquests against a divided Saracen foe in Armenia and Syria. To the north of Constantinople a powerful Bulgar state was forming, which included nearly the whole of the Balkan Peninsula. Against this the emperors of the 10th century waged almost constant warfare; but it remained for Basil II (976-1025), nicknamed Bulgaroktonos (slayer of Bulgars), finally to put an end to their power. Culturally Byzantine influence was extended far beyond the confines of the Empire, especially northward into Russia where commercial contacts and the conversion of the Slavs to the Orthodox faith paved the way for its penetration.

With the death of Basil II in 1025 the line of strong individual emperors came to an end. The country fell into civil anarchy. Though drawing economic strength from its key position in the eastern Mediterranean, and possessing a high degree of culture, the state was continually subject to sudden reversals because of failure to develop a really effective administrative system or to provide for orderly succession to the throne. To this internal difficulty was added a new menace on the eastern frontier in the expansion of Turkish power (*see* *TURKISH EMPIRE*) throughout the Saracen state. In 1071 the Turks defeated the Emperor at Manzikert, and placed the Empire definitely on the defensive in Asia Minor. At the same time the Normans, who had conquered southern Italy were threatening attack from the west.

**The Comneni Dynasty, 1081-1204.** To these problems the dynasty of the Comneni, 1081-1204, succeeded. The Emperor Alexius, 1081-1118, appealed to the west for aid and received it in the form of crusading armies led by land-hungry nobles who, while warding off the menace of the Turk, introduced new embarrassment for the Empire. (*See* *CRUSADES*.) Pressed by the Normans on the west, the Turks on the east, the Slavs on the north, severed from the Western Church by the schism of 1054 and facing graver and graver danger from each crusade that passed through their lands, the Comneni kept the Empire alive for a century and a quarter more. At last the end, or at least the end of the Empire's greatness, came, not from the Turks, but from the

western Christians. The Fourth Crusade starting for Egypt was diverted against Constantinople. Officially its purpose in attacking Constantinople was to restore to the Byzantine throne the boy Alexius, whose father, the Emperor Isaac Angelus, had been deposed. Alexius was the brother-in-law of the German King, Philip of Swabia; so support for diversion came from that quarter. Pope Innocent III was anxious to bring the Greek Church to obedience to Rome, and this hope may have stayed his hand at the decisive moments when he could have blocked the expedition. Above all Venice, which was furnishing the transportation, was interested in obtaining a better trading position in the Aegean and Black seas. In any event the Crusade took the city in the fall of 1203 and went through the pretense of restoring Isaac and Alexius. When these soon failed to fulfill the impossible demands of the Crusaders the city was again taken in the spring of 1204 and divided up among the Crusaders. Count Baldwin of Flanders became Emperor of the Latin Empire of Constantinople, and the Venetians obtained most of the islands and a tariff concession. A few fragments of the Empire in Anatolia remained in Greek hands, and with the fall of the Latin Empire in 1261 the Byzantine Empire was reconstructed under the Palaeologue dynasty. But it never even approached the greatness of its earlier days, and it was gradually reduced piece by piece. The Slavs and Bulgars advanced from the north. The Ottoman Turks held the Asiatic shore of the Sea of Marmora and the Bosphorus after 1355, and soon began crossing into Thrace at the Dardanelles. By 1453 when the Sultan Mohammed II began the last siege of Constantinople there was nothing left of the Empire but a few miles of land along the coasts of the Black Sea and Sea of Marmora and parts of the Peloponnesus.

**Civilization of the Byzantine Empire.** During the Middle Ages the Empire occupied a more important world position than its military strength would indicate. After 1071 it could never muster the force it possessed in the days when it held Anatolia, to say nothing of equalling its strength in the great days before the loss of Syria and Egypt; but

it presented a polished, highly cultivated urban civilization which exercised a deep fascination upon the simpler, rural society of western Europe. Constantinople was a huge city full of stores, industries, theaters and other amusements, when western Europe could boast of nothing in any way comparable. The Byzantines carried on an immensely varied trade from Scandinavia to Zanzibar, from China to Spain, in the days when commerce in the west was almost at a standstill. The attitude of western Europe towards Byzantium was usually a compound of awe and hatred which the Byzantines returned with secret fear and open contempt, feelings which the Crusades served merely to heighten. But the influences radiating from Constantinople were very great. From Constantinople the southern and eastern Slavs borrowed their religion and much of their culture. Byzantine contributions to western Europe are not so easily evaluated; but commercial development, especially of the Italian cities, was certainly much influenced by Constantinople; there was some borrowing in art; and, though the extreme claims of Byzantine influence upon the Italian Renaissance have now been considerably discounted, Byzantine scholars did assist in the spread of a knowledge of the Greek language and of Greek thought in northern Italy.

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**BYZANTIUM**, an ancient city on the shore of the Bosphorus, built about 658 B.C. by the Megarians; in the year 330 the city of Constantinople was built by its side. At the entrance of the Euxine Sea it commanded a position of great commercial importance. The city fell under the Persians and later to the Spartans from whom the Athenians tried to wrest it during the Peloponnesian War. Alexander the Great took it for Macedonia, and in 196 A.D. it was captured by the Romans under Severus, who destroyed the city and slew its citizens. In 330 A.D. Constantine rebuilt Byzantium and called it Constantinople, making it the capital of the Roman Empire in 330 A.D. *See* BYZANTINE EMPIRE; CONSTANTINOPLE.



## C

**CABAL**, a term applied to the secret machinations of a small group or to the group itself. It was also applied to the committee of foreign affairs in the reign of CHARLES II, germ of the modern English Cabinet. That committee included, in 1671, five members and the initial letters of their names made up the word cabal.

**CABBAGE**, the most widely grown and important vegetable of the seven developed during more than 20 centuries from one plant (*Brassica oleracea*) of the mustard family, which grows wild on the shores of northwestern Europe. This vegetable is distinguished from the other six, kohl rabi, collards, broccoli, cauliflower, brussels sprouts and kale, by the development of its more or less compact head, which is really an exaggerated bud since it consists of a compressed stem and leaves, the latter developing from within but swelling outward. Selection has produced hundreds of varieties which display several distinct types, small and large heads; early, mid-season and late; green and purple (red); conical, globular, oval and flat; smooth and crumpled leaves.

This vegetable does best in rich, well-drained but moist soil and cool weather. Seed for the summer varieties is sown in cold frames during the previous autumn, during late February in greenhouses or hotbeds or outdoors in early spring. Indoor grown plants must be gradually inured to cold before being set in the open ground. Only ordinary clean cultivation is necessary to success. Seed for late cabbage is sown outdoors in May or June, the seedlings transplanted a month or six weeks later and the heads gathered and used or stored in late autumn.

#### CABBAGE, COMMERCIAL PRODUCTION, U.S.

4-Year Average, 1927-30

Division	Acreage	Production (Tons)	% of Tot. Prod.
UNITED STATES .....	130,388	920,450	100.0
LEADING STATES:			
New York .....	29,440	262,725	28.5
Wisconsin .....	13,492	113,600	12.3
Texas .....	18,103	103,825	11.3
Louisiana .....	14,690	68,625	7.5
California .....	5,833	33,550	3.6
Minnesota .....	2,585	19,550	2.1

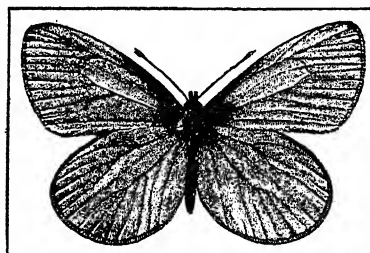
Chinese cabbage varieties, Pe-Tsai, Wong-Bok, and Chi-Hi-Li, have been developed from oriental species distinct from European varieties. They have been grown in China for more than 4,000 years, but only recently introduced in America. Cool weather is essential to their best development, and they fail as summer vegetables. In the vicinity of New York seed is sown about June 15 where the plants are to remain. When 3 in. high the seedlings are thinned to 15 in. asunder and cultivation proceeds the same

as for cabbage. In about 120 days from sowing the heads will be ready for table use as salad or as a vegetable cooked like cabbage.

M. G. K.

**CABBAGE-BUG**, a bug of the family *Pentatomidæ*, most common in the southern states, known also as the harlequin bug and the calico-back. Both adults and nymphs feed on host plants, causing them to turn brown and die. The adults are beautiful black insects with bright red markings. Their eggs resemble miniature white barrels with black hoops. These are laid on the under surfaces of leaves of cruciferous plants. Nymphs soon emerge and feed. In the far South these insects are active all winter, further north they hibernate as adults. In the South there are three or four generations annually. Clean culture and the use of trap crops are the best measures of control.

**CABBAGE BUTTERFLY**, a common white butterfly (*Pieris rapæ*) of the family *Pieridæ*. Introduced from Europe into Quebec about 1858, it is now widespread throughout North America. The adults appear in spring. Eggs are laid on numerous host plants, hatching in about a week. The caterpillars are velvety green in color; they pupate in about six weeks, in a green chrysalis on or near the host plant.



CABBAGE BUTTERFLY

Two or three broods per year occur in the North, but there may be three or four in the South. Caterpillars are serious pests on cabbage, where they feed in the heads. Other crops damaged by them include brussels sprouts, cauliflower, horseradish, kale, turnip, mustard and related plants. Nasturtiums are also attacked. Arsenate of lead, Paris green and other arsenicals applied in the dust form are effective controls, for use until plants are half grown. From then until harvest, pyrethrum extracts or hellebore should be used.

**CABELL, JAMES BRANCH** (1879- ), American novelist, was born at Richmond, Va., Apr. 14, 1879. He was graduated from William and Mary College in 1898, and was with the New York *Herald* from 1899-1901. For several years he wrote short stories, then engaged in coal mining in West Virginia, and in genealogical research. His work is distinc-

tively individual; in one book he creates an imaginary realm, Poictesme, the inhabitants of which are the ancestors of his other characters. Among his best known novels are *Beyond Life*, *The Silver Stallion* and *Jurgen*. Cabell published *These Restless Heads*, a series of essays, in 1932.

**CABINET**, politically, a council of ministers or administrative heads, advisory to the head of the state or to the chief executive. The British Cabinet composed of certain "King's ministers" is the oldest type and is the model for governments where the executive is politically responsible to parliaments or legislatures. In such cases their responsibility is collective and they stand or fall together. In the United States Government, the heads of departments are responsible solely to the President. They represent the Department of State, Treasury Department, War Department, Department of Justice, Post-Office Department, Navy Department, Department of the Interior, Department of Agriculture, Department of Commerce and the Department of Labor. (See separate articles on these departments.) They have no concern with the administrative actions of one another, and form a Cabinet only when called in by the President to advise him on public policies or affairs. These meetings may be regular or infrequent as the President desires.

**CABLE, GEORGE WASHINGTON** (1844-1925), American writer, was born at New Orleans, La., Oct. 12, 1844. As a young man he fought with the Confederates and wrote stories charged with the flavor of the old South. To his stories of New Orleans Cable owes his fame. While working with a cotton factor he wandered about the city and delved into its records. *Old Creole Days*, stories of a rare and delicate charm, were published in *Scribner's Magazine*, and later in book form. Other works include *The Grandissimes*, *Madame Delphine* and *Doctor Sevier*. Cable died at St. Petersburg, Fla., Jan. 31, 1925.

**CABLES, ELECTRIC.** See **ELECTRIC CABLES**.

**CABLE TRANSFERS**, an order directing the payment of money abroad by cable, is designated as a cable or telegraphic transfer (abbreviated t.t.). The cable transfer is analogous to the bill of exchange, in that it is an order for the payment of money, addressed by one person to another, requiring the person to whom it is addressed to pay a specified sum. Payment is, however, directed to be made to a designated person, rather than to order of bearer, and the cable transfer thus differs from the negotiable bill of exchange. It lacks, also, a written signature. To guard against the execution of fraudulent cable transfers, banks transmit such orders in secret codes.

**CABLEWAYS.** See **ROPEWAYS AND CABLEWAYS**.

**CABOT, GEORGE** (1751-1823), American statesman, was born at Salem, Mass., Dec. 16, 1751. At 17 he left Harvard College to go to sea as a cabin boy. Before reaching 21 he was a captain, and subsequently became a prosperous shipowner and merchant. He served in the provincial congress in 1775 and in the state senate, 1782-3, and was a delegate to the Massachusetts constitutional convention, 1779-

80, and to the convention of 1787 which ratified the federal Constitution. In 1791-96 he was U.S. Senator from Massachusetts. President Adams appointed him the first Secretary of the Navy in 1798, but he declined the office. An expert economist, Cabot helped frame the financial policy of the new government. He was a prominent leader of the Federalist party, belonging to the famous "Essex Junto" which advocated close economic and political cooperation with England. In 1814 he presided at the Hartford Convention. He died in Boston, Apr. 18, 1823.

**CABOT, HUGH** (1872- ), American surgeon, was born at Beverly Farms, Mass., Aug. 11, 1872. He graduated at Harvard University in 1894 and in 1898 obtained his degree of M.D. He practised medicine in Boston, being assistant surgeon and surgeon at the Mass. General Hosp. 1902-19; surgeon at the Baptist Hosp., 1900-19. He was assistant professor of surgery at the Harvard Medical School, 1910-18, clinical professor in 1919. The same year, however, he became professor of surgery at the University of Michigan, where he has since remained, becoming dean of the Medical School in 1921.

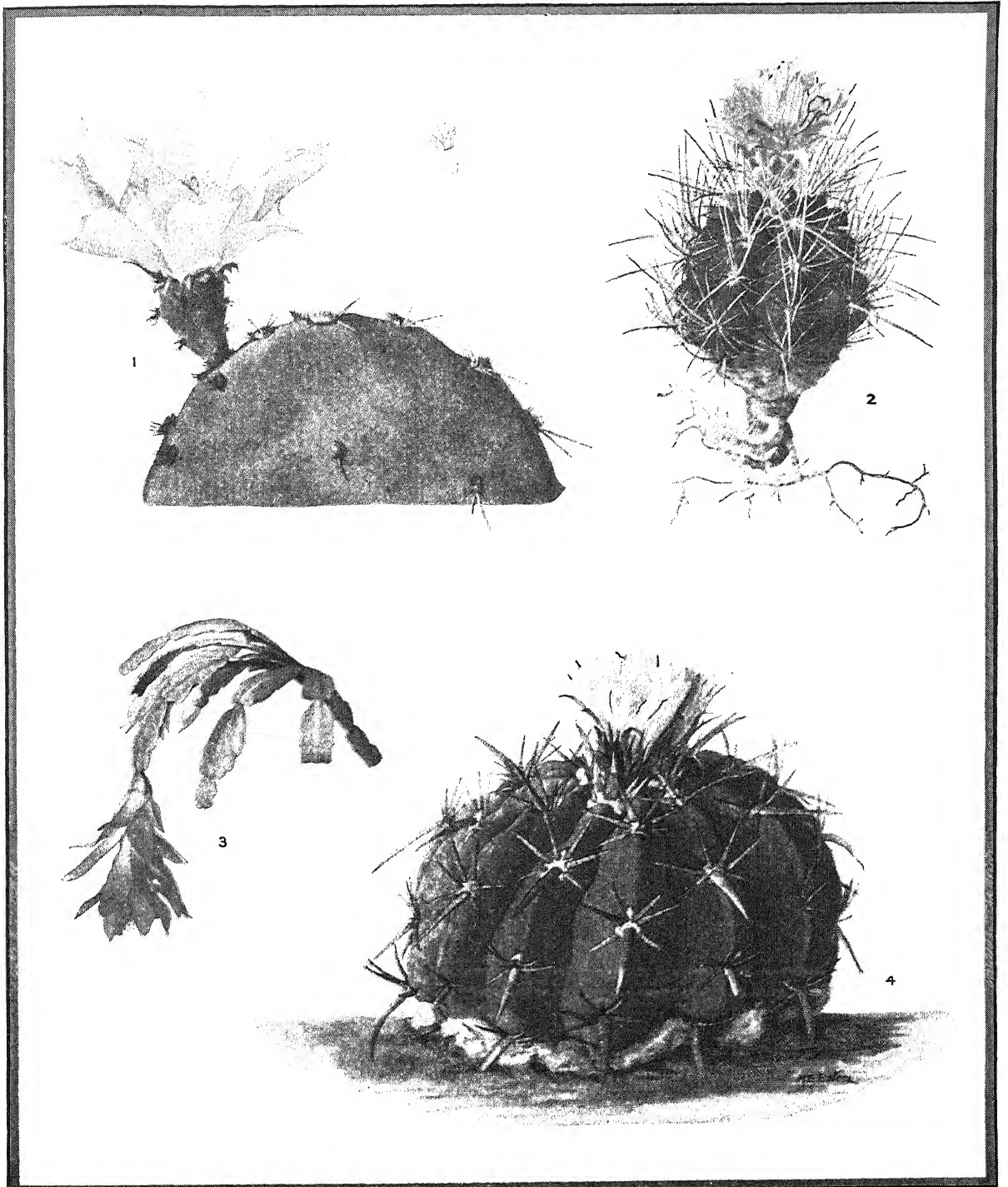
**CABOT, JOHN** (1450-98), Italian explorer, was born in Genoa, Italy, in 1450. He moved to Venice and later to England. From his experience at Venice in trading on the Mediterranean, together with reports of navigators from England to Iceland, he was convinced that the earth was round, and of a western route to Asia. Cabot succeeded in interesting King Henry VII, and in May, 1497, sailed in the *Mathew*. On June 24 he discovered Cape Breton and other islands in the Gulf of St. Lawrence, and actually landed on the shore of North America. Returning to England in August, where he was favorably received, money was advanced for another expedition. This expedition left England early in 1498, explored the coasts of Greenland and Newfoundland, returning the same year. He died about 1498.

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**CABOT, RICHARD CLARKE** (1868- ), American physician, was born at Brookline, Mass., May 21, 1868. He was graduated from Harvard University in 1889, taking the degree of M.D. in 1892. Since 1900 he has been connected in several capacities with the Mass. General Hosp., being chief of staff, 1912-21. He is also consultant in several other hospitals and schools. He has likewise been connected with the Harvard Medical School since 1899, being successively assistant instructor in medicine, assistant professor and, since 1919, professor. He saw service in France during the World War, being major and lieutenant-colonel in the Medical Reserve Corps. He is author of several medical publications, among the best known being *Physical Diagnosis* and *Differential Diagnosis*.

**CABOT, SEBASTIAN** (c. 1472-1557), navigator and cartographer, son of JOHN CABOT, was born about 1472. Entering the service of Charles V of Spain after having served Henry VIII of England in a mili-

## CACTUS



PAINTED FOR THE NATIONAL ENCYCLOPEDIA BY MARY E. EATON

### CACTUS TYPES IN FLOWER

1. Prickly Pear (*Opuntia Lindheimeri*), a typical marginal flower (sometimes  $3\frac{1}{2}$  inches across), and part of a flattened joint of the stem. This Prickly Pear is native to the southwestern United States and to Mexico, and grows, usually erect, 3-12 feet high. 2. Hedgehog Cactus (*Echinocactus bicolor*), a small species, 8 inches high, with globose-ovate, 8-ribbed body, exceedingly sharp spines 3 inches

long, and bright pink-purple flowers 2-3 inches long. It is native to northern Mexico. 3. Crab or Christmas Cactus (*Zygocactus truncatus*), native to southern Brazil and often cultivated as a window plant. 4. Hedgehog Cactus (*Echinocactus texensis*). This Hedgehog Cactus, native to Texas and northeastern Mexico, has a depressed spherical body, very stout spines, and parti-colored flowers.



tary expedition, Sebastian had advanced by 1518 to the head of the Spanish navigation office. In 1525 he was given command of three vessels, explored the South American coast and La Plata River, returning to Spain after an absence of around three years. In 1548 he went to England, was given a pension by King Edward VI, and was active in maritime matters. He died about 1557.

See F. A. Ober, *John and Sebastian Cabot*.

**CABRAL, PEDRO ALVARES** (1460-1526), Portuguese navigator, discoverer of Brazil, was born in 1460. His life is little known except the period 1500-01, when King Manuel of Portugal entrusted him with 13 ships and 1,500 men to repeat the voyage of Vasco da Gama to India by the Cape of Good Hope. The expedition left Lisbon Mar. 9, 1500, and arrived at Cape Verde. Here it turned toward the southwest and, driven by tempests, or possibly intentionally, touched the coast of Brazil. Although Vicente Yanez Pinzon had already coasted along the northern shores of Brazil, no importance was given to his discovery, and Cabral received the fame, taking possession in the name of King Manuel of Portugal, and calling it Terra Sanctae Crucis. He sent a ship to Portugal to announce the discovery and started toward the Cape of Good Hope, and thence to India. After visiting several points along the coast and the Island of Ceylon, he loaded his ships with riches and, taking ambassadors to solicit the protection of Portugal, returned to Lisbon, with only six ships. King Manuel received him with such coldness that he retired to private life. Some authorities declare that the king entrusted him with a new expedition, which he refused because of the restrictions imposed.

**CABRILLO NATIONAL MONUMENT**, a half-acre tract of land on Point Loma near San Diego, Calif. Juan Rodriguez Cabrillo, Spanish navigator and discoverer of the territory now partly embraced in the State of California, first sighted the mainland at this place Sept. 28, 1542. The monument area was set aside by presidential proclamation, Oct. 14, 1913, and is under the administration of the War Department. It is reached by automobile from San Diego which is on the Southern Pacific and Santa Fé railroads and U.S. Interstate Highway No. 101.

**CA'CANNY**, a term, more frequently employed in Great Britain than in the United States, to designate conscious restriction of production or "going slow" by individual workers, in an effort to avoid speeding up processes, penalties visited upon the less efficient, or reduction of piece rate (see **PIECE WORK**) as a result of the establishment of higher standards of output.

**CACAO** (*Theobroma Cacao*), a small evergreen tree of the sterculia family extensively planted for its seeds. It is a native of Central and South America widely cultivated in many tropical regions. The tree grows usually 20 to 25 ft. high with widely spreading branches, large oblong leaves and small yellowish flowers borne in clusters directly on the bark of the trunk and main branches. The huge podlike

fruit, about a foot long and four inches in diameter, contains within its thick, hard wall numerous flat seeds imbedded in a whitish pulp. From these seeds, called cacao beans, are prepared the various forms of **CHOCOLATE** and **COCOA** and also cocoa butter, a solid fat, almost as hard as beeswax, used in pharmacy.

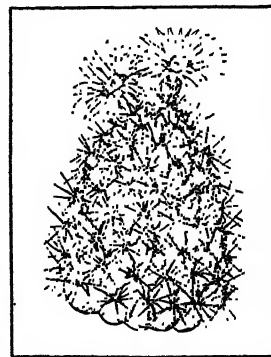
**CACHALOT**, see **SPERM WHALE**.

**CACODYL COMPOUNDS**, organo-metallic compounds containing the group  $\text{As}(\text{CH}_3)_2$ , known as dimethylarsenic, and characterized by their loathsome odor and poisonous effect. Cacodyl itself, constituted from two such groups, is a heavy, oily liquid, which undergoes spontaneous combustion when exposed to air. Cacodyl oxide,  $\text{As}_2(\text{CH}_3)_4\text{O}$ , may be prepared from arsenic and potassium acetate, and is very poisonous, but by oxidation is transformed into cacodylic acid,  $(\text{CH}_3)_2\text{AsOOH}$ , no longer poisonous, and even possessing a distinct therapeutic value, having been used with success in cases of leprosy, syphilis, and diabetes.

**CACOMISTLE** (*Bassariscus astutus*), a small carnivorous mammal, body about 16 in. long, related to the raccoon and inhabiting Mexico and southwestern United States. It is known by various names, as bassarisk, raccoon-fox, mountain-cat, American civet-cat, and ring-tailed cat, from the alternate whitish and dusky rings about its bushy, upward-curving tail, which is the same length as its body. It is a pretty, intelligent animal with a fox-like face, large, bright eyes, and pointed ears that are almost bare. The fur is long and soft, brown about the head, shading to darker along the back, and whitish underneath. Light patches tip the ears and circle the eyes. Cacomistles prefer rocky slopes and canyons and use caves and crevices in cliffs for nesting and breeding places. In their habits they are more active than raccoons. They feed on smaller mammals, birds and insects. Though fierce, they are easily tamed and are kept as pets and for destroying rats.

**CACTUS**, a large family of succulent, **DESERT PLANTS**, nearly all of them prickly, and all but a few in one genus confined to the New World. They are adapted by the general absence of leaves, the tremendous water-storage capacity of their usually swollen stems and their great root development, to an arid environment.

Cacti, of which over a thousand species are known, have a bewildering variety of forms. Some, like the dangerously poisonous mescal button, are small and inconspicuous. Others are epiphytes, with slender almost whip-like stems. A few, like the beautiful night-blooming cereus, are climbers. The most fantastic cacti are the tall, columnar kinds of which the



P. A. RYDBERG. "FLORA OF PRAIRIES AND PLAINS"

**BALL OR NIPPLE CACTUS**  
*Neomammillaria vivipara*



**SAGUARO** is among the largest. They are often branched, and some species form impenetrable thickets.

While cacti are found in all the warmer parts of the New World, their greatest frequency, both as to species and individuals, is in southwestern United States and adjacent Mexico. A few of them are of importance as stock feed, but most cacti are covered with spines, some very sharp and hard, others, as in the Turk's-head cactus, are hooked. The function of these prickles is not understood, freedom from animal pasturage and other factors being involved in their evolution.

The use of some spineless forms of the prickly pear as stock food led to their introduction into the Mediterranean region, China and Australia, where they have become pernicious weeds. The edible berries of many species, especially the tuna and Indian-fig, are widely used in tropical regions; the fruit and seeds of a number of species are used by the American Indian for food. Otherwise the cacti are of little economic importance, except the **COCHINEAL** cactus which was formerly widely cultivated as the host of the insect producing a scarlet dye, cochineal.

Many cacti are cultivated for ornament and as hedge plants. Some, such as the Christmas cactus and night-blooming cereus, are well known house plants. Others are grown for their weird shapes, their beautiful flowers, or as subjects for the desert garden. N. T.

**CACUS**, in Roman mythology, a giant robber, the son of **VULCAN**. He lived in a cave on Mt. Avenine. The giant stole some of the cattle that **HERCULES** had taken from Spain, but the theft was disclosed by the howling of the stolen cattle, when the rest of the herd passed. Hercules entered the cave and slew the robber.

**CADDICE-FLIES**, small moth-like insects of the order *Trichoptera*. Adults have membranous wings clothed with long, silky hairs. These, when not in use, are folded roof-like over the abdomen. The mouthparts are vestigial. The eggs are laid in masses either in water or on objects above water, and the larvæ are aquatic. Many larvæ are caterpillar-like in appearance, have chewing mouthparts, and feed upon plants and smaller insects. Numerous species build portable cases in which they live, dragging them about as they move. Some cases are entirely of silk, but most contain other materials, as leaves, sticks, small stones and sand grains. The pupæ are likewise aquatic, remaining within the larval case. These insects are sometimes known as case-flies, stick-worms and stick-bait. The larvæ are eaten eagerly by fishes, especially the brook trout. J. R. T.

**CADDO**, an important tribe in the confederacy of the southern group of the **CADDOAN** linguistic stock. Traditionally their aboriginal home was on the lower Red River in Louisiana. They were a semi-sedentary people, dwelling in grass-thatched conical lodges, agriculturists, potters, weavers of vegetable fiber cloth and basketry. Living in the southern part of the buffalo range, they also hunted the bison and used its skin

for clothing. Their most important rituals were connected with the cultivation of maize, hunting and the securing of long life and peace. Socially they were organized into clans with matrilineal descent.

**CADDOAN**, an American Indian linguistic stock which may be classified in three geographical groups: the northern, to which belong the **ARIKARA** in North Dakota; the middle, which included the Pawnee Confederacy formerly living on the Platte River in Nebraska; and the southern group, which includes the **CADDO**, **Kichai** and **Wichita** scattered in Louisiana, Arkansas and in southern Oklahoma and northeastern Texas. The original home of the stock appears to have been in the Southwest whence they migrated eastward to the territories where they were first encountered in historic times by Europeans, contact with whom in a relatively short time, followed by war and disease, considerably depleted the original population. The present-day Caddoan peoples live on allotted lands in Oklahoma and North Dakota. They appear always to have combined an agricultural, semi-sedentary village life with hunting, and made pottery, wove baskets and dressed skins. For dwellings they used both the grass- and earth-lodge. Their rituals were elaborate, dealing with maize and the quest for long life and health.

**CADELLE**, one of the meal worms. The larva of a small oblong beetle (*Tenebrioides mauritanica*) of the family *Ostomidæ*. It is a common pest in stables, barns, mills, granaries and sometimes in houses. It feeds on meal and flour, eating the germs of grain. Adults feed on grain, also injuring bolting cloth and bags. Both larvæ and adults are also predaceous. Scrupulous cleanliness and storing food in tight containers will prevent infestations. Heating to a high temperature and fumigation are effective methods of control. The yellow and dark mealworms of the family *Tenebrionidæ* are injurious insects which likewise attack grain.

**CADENCE**, in music, is a rounding out of a phrase, being a term derived from the Latin *cadere*, to fall, and thus implying a falling of a phrase which seeks a point of rest. Three different types of cadence are generally recognized: 1, the authentic, 2, the plagal, and 3, the deceptive, or false, or interrupted. In the first, the dominant chord is succeeded by the tonic; in the second, the subdominant is succeeded by the tonic; in the third, the dominant is succeeded by various other chords selected at will, although the chord on the sixth degree of the scale is commonly used. The following cadences illustrate these three variants:



**CADENZA**, a musical flourish, vocal or instrumental, in which the performer is given a chance to

display his technical agility or virtuosity. It was a regular feature of the concerto during the classical and romantic periods, occurring near the close or final cadence.

**CADET**, a military title applied to students under training for commissions in the army, or to those in similar training in private military schools. *See also* MIDSHIPMAN.

**CADI** or **QADI**, the Moslem judge who, in theory, decides questions of civil and criminal law. In practice, however, his functions have been limited to "religious" law, and of late he has held a place of only minor importance in the Moslem community. Only such questions as relate to family law, inheritance and the administration of funds in support of religion are brought before him. The secular authorities administer the larger issues of the law.

**CADILLAC**, a city and county seat of Wexford Co., western Michigan, situated 55 mi. southeast of Traverse City. It is served by the Pennsylvania and Ann Arbor railroads and is the trade center for the lumbering region of northern Michigan. The chief industrial establishments include lumber mills, and plants which manufacture furniture, wood products, trucks, iron and chemicals. Cadillac is also a summer resort, known for its trout fishing. The region produces principally truck crops, fruit, sugar beets, potatoes and wheat. Immediately west of Cadillac is William Mitchell State Park. The original settlement was called Clam Lake, founded in 1871. The city was chartered under the present name in 1877 and rechartered in 1895. Pop. 1920, 9,750; 1930, 9,570.

**CÁDIZ**, a city in Spain, capital of Cádiz province, and important as a fortress and seaport. Founded by the Phoenicians about 1100 B.C., Cádiz is one of the oldest cities in Europe and always has been an important commercial city. With the exception of the oldest part, it is regularly built with open squares, a promenade and a park. Noteworthy buildings are the old cathedral, rebuilt in 1597, and the new one, built 1722-1838, the former Capuchin abbey and the city hall. Cádiz produces tobacco products, jewelry, gloves, fans, soap, cotton and hemp goods, and builds ships. Its chief imports are lumber, barrel staves, machines and coal. The exports include sherry wine, tartar, olive oil, olives, sea salt and brandy. Est. pop. 1929, 78,986.

**CADMAN, CHARLES WAKEFIELD** (1881- ), American music composer, was born at Johnstown, Pa., Dec. 24, 1881. He studied at Pittsburgh, where he obtained a post as organist. In 1904 he became interested in Indian music, later composing many songs based on Indian modes. His Indian opera *Shanewis* was produced at the Metropolitan Opera, New York, in 1918, and *A Witch of Salem* was presented by the Chicago Civic Opera in 1926.

**CADMAN, SAMUEL PARKES** (1864- ), American clergyman and author, was born in Wellington, Shropshire, England, on Dec. 18, 1864. In 1889 he was graduated from Richmond College, and, coming to the United States in the following year, at-

tended Wesleyan and Syracuse Universities. From 1895, when he became pastor of the Metropolitan Temple in New York City, until 1901 he was a leader in the progressive movement of Methodism. In 1901 he became pastor of the Central Congregational Church in Brooklyn. During 1924-28 he was president of the Federal Council of Churches of Christ in America, and since 1928 has been the radio minister for the Council and the National Broadcasting Co. In 1930 he was elected president of the Golden Rule Foundation. He has published *William Owen; A Biography*; *The Victory of Christmas*; *Charles Darwin and other English Thinkers*; *Christianity and the State*; and other works.

**CADMEAN VICTORY**, a term used in referring to a victory which has been won at exorbitant cost. The expression is derived from the myth of Cadmus, the hero who tossed a precious stone among the warriors which had sprung miraculously from the sown dragon's teeth to confront him, and watched them kill all but five of their number in their struggle for the jewel. An equivalent meaning is found in the phrase **PYRRHIC VICTORY**.

**CADMIUM**, a silver-white metallic element of a slightly bluish cast, occurring with zinc and closely related to it. It is soft, malleable and ductile. It melts at 321° C., boils at 778° C.; sp. gr., 8.6-8.7; at. wt., 112.4. It is bivalent and is readily soluble in mineral acids, but not affected by alkalis except ammonia. Soluble cadmium compounds are highly toxic.

**Production.** Cadmium is obtained from the processing of zinc ores for the recovery of pure zinc and zinc compounds. It is separated from the other impurities, and recovered electrolytically. Production has increased very rapidly in the last ten years. The 1929 figures for the United States and Canada show metal produced 2,481,427 pounds, valued at \$2,009,956; metal content of cadmium compounds, estimated at 433,300 pounds, value \$498,734. Imports were 214,307 pounds, valued at \$184,527.

**Uses.** Cadmium metal is used principally as a corrosion protective coating and finish for iron and steel, to which it is applied by electroplating from cyanide baths. The metal is also used to a limited extent in low melting alloys, special solders, and in the manufacture of standard electromotive force cells. The principal commercial compounds are the oxide, used in electroplating; and the sulphide, used in paints and ceramics on account of its stability.

L. R. W.

**CADMIUM STANDARD CELL.** *See* CELL, VOLTAIC OR PRIMARY.

**CADMUS**, the mythological founder of Thebes, son of Agenor, King of Phoenicia, and brother of EUROPA. When ZEUS carried off Europa, Cadmus started in search. He consulted the oracle at Delphi and was told to walk until he met a cow, to follow her and then build a city where she lay down. He was led to Boeotia where he founded the city of Thebes. He was next commanded by Athene to kill

a dragon and sow its teeth. From these sprang up a force of armed men, who, stirred up by Cadmus, battled together until only five of them were left. The five are supposed to be the ancestors of all the Thebans. Cadmus married Harmonia, daughter of ARES and APHRODITE. Many inventions were ascribed to Cadmus and he is said to have introduced an alphabet into Greece.

**CADORNA, COUNT LUIGI** (1850-1928), Italian general, was born at Pallanza, Sept. 4, 1850. Educated first at a cadet school he then entered the Staff College as aide to his father, General Raffaele Cadorna. He advanced rapidly, becoming chief of staff in 1914. When Italy declared war in 1915, Cadorna was given command of the Italian campaign in the region of the Trentino, the Dolomites, and the Carnic and Julian Alps. He won several battles in 1916, the effect of which was offset by the disastrous Caporetto defeat of Oct. 1917, when the Austro-German offensive cost the Italians about 250,000 men and 2,300 guns. In November of the same year he was made a member of the Allied Military Council from which he retired, Feb. 1918. In 1924 he was given the rank of marshal. Cadorna died at Bordighera, Italy, Dec. 21, 1928.

**CADOUDAL, GEORGES** (1771-1804), a leader of the resistance against the French Republic, was born on Jan. 1, 1771, in Brittany. He organized a revolt against the Republicans in the Morbihan, then joined the Vendéans, was taken prisoner, but escaped to become the leader of the Chouannerie (see FRANCE: History). Whenever his work in inciting the peasants of Brittany became dangerous, he escaped to England. In 1803 he returned to France with funds to organize a rising in Paris against the Consulate and Napoleon, but was suspected of conspiracy, was imprisoned, and was executed with several others on June 25, 1804.

**CADRE**, a frame, outline or skeleton. In a military sense it is applied to the commissioned and non-commissioned officers and other elements necessary to the continuous existence of an organization which serve as a skeleton around which a war-strength organization can be built. It is derived from the French Army.

**CADUCEUS**, in classical mythology, a magic wand. Some caducei were winged and others were coiled with serpents. MERCURY carried a

caduceus and so, occasionally, did Iris. With this staff the bearer could go anywhere in safety.

**CÆCILIAN** or "blind worm," familiar name for members of the most primitive order (*Gymnophiona*)

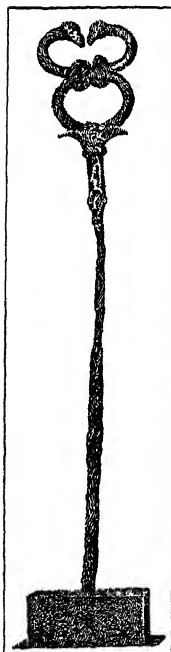
of amphibians. There are about 40 species, found in tropical countries. They look like big earthworms, as they have no limbs and but a rudimentary tail. Their eyes are poor, or quite degenerate and blind. Most species are burrowers, but a few are aquatic. Some lay eggs; others bear living young.

**CAECILIUS STATIUS** (? -c. 168 B.C.), Roman poet and writer of comedy, was born a member of the Celtic Insubrians, and about 200 B.C. was brought to Rome as a prisoner. After his liberation he apparently supported himself by adapting Attic comedies to the Roman theater. Fragments of these adaptations and of original works are extant. His *Fabulae palliatae*, or improvisations on Greek themes, gave him first place among the comic poets of his time. He died about 168 B.C.

**CAEDMON** (d. 680?), first English writer using the contemporary English language as his literary medium. The Venerable BEDE is our sole source of information concerning him. He devotes a chapter of his *History* to Caedmon, telling us that as a youth he was quite devoid of any talent for poetry, and was never able to comply with requests at feasts to sing or recite. But once, as he was watching the beasts in the stables while others sang and recited at a feast, a vision came to him, telling him to have confidence in himself and to "sing the beginning of created things." On awakening Caedmon found that the poetic inspiration had not deserted him and he began to extemporize poems based on biblical stories and religious subjects. He was conducted to Hilda, Abbess of Streaneshalch, and in due course became a monk, continuing to compose his religious poems. Bede asserts that "none of those who came after him to make religious poems could vie with Caedmon, for he did not learn the poetic art from men, but from God." Caedmon died about 680.

**CAELUM** (gen. *Caeli*), the chisel, an insignificant constellation between Eridanus and Columba.

**CAEN**, a city in Normandy, noted for its architectural riches. The Abbey Churches of St. Étienne and La Trinité were built by William the Conqueror and his wife, Matilda, who were cousins, to expiate their sin in marrying without special dispensation. Both were built about 1063-77, and both were vaulted in the 12th century. They are among the most interesting examples of Norman architecture. St. Étienne, known as the Abbaye aux Hommes, is massive and severe. The façade is flanked by two fine towers; the choir was rebuilt in the Gothic style in the 13th century. La Trinité, the church of the Abbaye aux Dames, is equally attractive, though somewhat lighter in effect. Its apse is of the 12th century, with a 13th century chapel. William was buried in St. Étienne in 1087. The Gothic church of St. Pierre is especially celebrated for its beautiful 14th century tower. Caen was long disputed between France and England, becoming finally French in 1450. The modern town, capital of the department of Calvados, has varied industries, but is primarily commercial. Pop. 1931, 57,528.



COURTESY M. OF FINE ARTS, BOSTON

A GREEK CADUCEUS OF BRONZE AND IRON

**CAERLEON**, a village of Monmouthshire, England, on the Usk, about 135 mi. west of London. As *Isca*, from the second half of the 1st century it was the station of the Roman Legio II, and extensive excavations carried on since 1926 have revealed buildings, roads and fortifications of Roman and British origin. Caerleon also is traditionally identified with Arthurian *Camelot*, and Tennyson spent several months in the town while preparing his *Idylls of the King*. Unfortunately, there is little in the modern town reminiscent of its glamorous past. Pop. (of district and town) 1921, 2,293; 1931, 2,326.

**CAESAR, GAIUS JULIUS** (100-44 B.C.), Roman military leader and statesman, was born July 12, 100 B.C. Although an aristocrat by birth Caesar early in life identified himself politically with the democratic party opposed to the senatorial nobility. He fled from Rome during the Sullan reign of terror in 82 B.C., escaping death at the hands of the dictator only through the intercession of powerful friends. **LUCIUS SULLA** died in 78 B.C., and Caesar rejoined the surviving democrats in Rome after his oratorical studies in Rhodes and some minor military experiences in eastern Mediterranean lands.

His political fortunes rose with the consulship of **GNAEUS POMPEY** and **MARCUS CRASSUS** in 70 B.C. when most of the laws of Sulla were abrogated. The following year Caesar went as quaestor to Farther Spain. In 65 B.C. he was aedile and in 63 B.C. pontifex maximus. Even the suspicion that he was privy to the conspiracy of **LUCIUS CATILINE** failed to halt his success. In 62 B.C. he was elected praetor and at the expiration of the year served with distinction as proprator in Spain. His first conspicuous political success was the formation of the First Triumvirate in 60 B.C. Caesar by this stroke drew to his side the two most powerful politicians of the day: Pompey, by virtue of his brilliant military campaigns in the East; and Crassus, by virtue of his vast wealth and his recent suppression of the slave revolt in Italy. Pursuant to the terms of the agreement Caesar became consul in 59 B.C. and was commissioned to proceed after his term to Illyricum and Cisalpine and Transalpine Gaul as governor for a period of five years. This was later extended to 10 years. His military exploits in the West rivaled those of Pompey in the East. The whole of Gaul from the Pyrenees to the Rhine was brought under Roman dominion, a German invasion of the Gallic lands frustrated, and two warning expeditions sent out to the shores of Britain.

These achievements served only to intensify the bitterness of the senatorial oligarchy toward Caesar and to stir jealousy and suspicion in the breast of Pompey. In 53 B.C. Crassus perished while on his campaign against the Parthians, and the following year Caesar was confronted with a general rebellion in Gaul. At this critical hour Pompey went over to the senatorial party. He was named sole consul for the year 52 B.C. and became the acknowledged military and political leader of the opposition to Caesar. The decisive break between the former allies occurred

Jan. 1, 49 B.C., when the Senate ordered Caesar to lay down his command and return to Rome as a private citizen. Caesar, well knowing that defiance meant civil war, replied by crossing the Rubicon that lay between his province and Italy and marching upon Rome. Pompey, surrounded by terrified senators, fled across the Adriatic with a hastily mobilized army. Caesar entered Rome without a struggle. The next few months tested his military genius to the utmost. While Pompey was mustering his forces in the Greek East Caesar hurried to Spain and crushed his enemies there, returned with amazing speed to Italy, and set out across the Adriatic. He defeated the Pompeian forces at Pharsalus, Aug. 9, 48 B.C., pursuing the senatorial commander to Egypt. There Pompey was treacherously slain at the order of the reigning Ptolemy. Caesar, blockaded for a time in Alexandria, met the young **CLEOPATRA** whom he wooed and placed on the throne. The remnants of the senatorial army he defeated at Thapsus in northern Africa, 46 B.C., and at Munda in Spain, 45 B.C.

These victories, leaving Caesar military master of the Graeco-Roman world, imposed upon him the stupendous task of reorganizing the political machinery both in Italy and abroad. His central political aim was clear. He proposed to rule the empire as an autocrat, realizing that the senatorial oligarchy had proved its incapacity. Constitutionally the new power of Caesar rested upon the dictatorship and upon the concentration in his hands of the old republican offices, notably the consulship and the tribunate. The Senate he degraded by increasing its membership, admitting provincials, and making the body wholly subservient to his will. He assumed complete control of the army and public finance. He brought under his personal supervision the governors of the provinces. He undertook to regulate and systematize municipal government throughout Italy. His economic and social reforms included a drastic reduction in the number receiving the dole of grain, fixing the maximum rate of interest at 12%, the settlement of veterans on the sites of Carthage and Corinth, and liberal extensions of citizenship to many provincial communities. He reformed the archaic and unscientific Roman calendar. He had in mind the codification of the Roman law, the construction of a canal through the isthmus of Corinth, and a detailed survey of the material resources of the empire, but he did not live to carry out these projects.

The plot against Caesar's life was organized by a group of irreconcilable nobles led by **MARCUS BRUTUS** and **Gaius Cassius**. They surrounded him in the Senate chamber, Mar. 15, 44 B.C., and stabbed him to death. Their act was prompted by the fear that Caesar planned to set up a monarchy in Rome.

The true greatness of Caesar lies in the fact that he perceived more clearly than any man of his age the fundamental weakness, ineptitude and corruption of the senatorial oligarchy confronted with the rule of a world state and that he had the courage to apply the axe to the root of the system. However, he has

been criticised by some modern scholars for his failure to go through the form of sharing his authority with the Senate, an institution, after all, symbolical of the past greatness and power of Rome. S. T.

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**CAESIUM**, a chemical element belonging to the alkali metals, having properties similar to those of potassium. Its chemical symbol is Cs., at. wt. 132.81. It was the first element discovered by means of the spectroscope (Bunsen and Kirchhoff, 1860). It occurs widely distributed in nature, but always in minute quantities; it is little used.

**CAFFEIN**, known also as thein, an alkaloid obtained from coffee and tea. The pure substance consists of white, silky, efflorescent, odorless needles, soluble in water and in alcohol. As a drug it is generally used in the form of tablets in combination with other substances. It acts by increasing the output of urine (diuretic) and is also a stimulant to the heart and the brain. These same actions occur after drinking tea or coffee. The average cup of coffee contains approximately  $1\frac{1}{2}$  to  $1\frac{3}{4}$  grains of caffeine. Caffeine is also a common ingredient in certain popular soft drinks. See also **COFFEE**.

**CAGLIARI**, capital of the province of the same name and of the island of Sardinia, on a wide gulf on the south coast of the island. The city lies on a hill surmounted by a citadel, below which are the cathedral, museum, university and the remains of a Roman amphitheater. The newer sections extend down to the harbor, and fine promenades have replaced the city walls. It is the seat of an archbishop. The inhabitants engage in shipbuilding and other industries and there is a brisk trade in agricultural products. Since 1928, Cagliari has been a free port, whence large quantities of salt and ores are exported. There is regular steamship service from Cagliari and other Sardinian ports to Naples, Civitavecchia, Genoa, Palermo and Tunis, and air service with Rome. Pop. 1931, 101,878.

**CAHOUN NUT**, the fruit of a lofty palm (*Attalea Cahune*), native to Central America. The slow growing tree, 50 to 60 ft. high, bears a dense head of long pinnate leaves and large clusters of three-seeded nuts. The kernels yield a valuable oil, finer than that of the coconut, which is used in soap making.

**CAHUILLA**, an important tribe of California Indians speaking a dialect of the Shoshonean linguistic stock. They have been Catholicized and now speak Spanish. Their territory lies between the San Bernardino Range and the mountain range which stretches southward from Mount San Jacinto in southern California. In their aboriginal culture the Cahuilla seem to have come indirectly under the influence of the Mohave and other tribes of the Colorado River. For food they depended almost entirely on the plants of their environment, grinding and drying

seeds and berries; in form and technique their basketry is almost indistinguishable from that of the Mission Indians. They made crude pottery and lived in thatched houses. The modern dwelling, however, is rectangular with slightly ridged roof, and mud or adobe plastered walls. The Cahuilla are organized into patrilinear, totemic, exogamous moieties. In 1931 the population was about 750.

**CAICOS**, a group of about 30 small islands comprising an area of 165 sq. mi. and forming a dependency of JAMAICA. Chief of the group is Grand Caicos, having a length of about 25 mi. and a maximum breadth of about 12 mi. Salt-raking is the most important industry and constitutes the chief export, together with cotton and sponges. The island of Grand Turk, 7 mi. long and 2 mi. wide, is the capital of this group. The Caicos group are geographically a part of the Bahamas, although politically a dependency of Jamaica. Est. pop. 1929, 4,996, including the Turks Islands.

**CAILLAUX, JOSEPH MARIE AUGUSTE** (1863- ), French statesman, was born at Le Mans on Mar. 30, 1863. He early showed brilliant intellectual attainments, and was appointed minister of finance in 1899. In his second term, which began in 1902, he introduced the French income tax. Made premier in 1911, he resigned in 1912, and in 1913 became minister of finance under Doumergue. In 1914 Mme. Caillaux shot and killed Gaston Calmette, editor of *Figaro*, who had conducted a violent campaign against her husband. As counsel at her trial, Caillaux procured his wife's acquittal, but himself resigned public office. Accused during the war of criminal "defeatism," he was sentenced to a short imprisonment and prolonged loss of civil rights, although he defended himself brilliantly and most of the charges against him went unsustained. Included in the amnesty of 1924, he returned to public life to become minister of finance in 1925. He held conferences in London with Winston Churchill and in Washington with the United States Debt Commission on the subject of international debts. His financial policy met serious opposition in France, and he resigned. He returned as minister of finance in 1926, only to resign once more, and retired to private life.

**CAIMAN**, or South American alligator, terms applied to crocodilians allied to the North American alligator and, together with it, distinguished by several characters from other New World crocodilians. A simple distinction is found in the fact that the fourth tooth of the lower jaw of the caiman and alligator fits into a pocket of the upper, while in the true crocodiles this tooth fits into a notch. The caimans are widely distributed in South America where they sometimes occur in great numbers. Their habits are in general like those of the alligator. The black caiman of the Amazon Basin reaches a length of 13 ft. and is the largest and most familiar of the seven known species.

**CAIN**, according to the tradition preserved in the fourth chapter of the Book of Genesis, the eldest son of Adam and Eve and the murderer of his brother



Abel. Scholars have pointed out that his story, as related, implies the existence of other peoples on the earth apart from the family of Adam, and have thus sought to explain the old riddle as to where he obtained his wife. The narratives in the Bible appear to give him a double character, that of a husbandman and also of a builder of cities, which may indicate the presence of two traditions. Those who regard the story as legendary believe that it was written to account for the presence of nomads in Canaan.

**CAINAN** is variously mentioned in the Book of GENESIS as Canaan, Cain and Kenan, and is referred to as the fourth son of Ham and also as the son of NOAH, who by a curse makes him "a servant of servants to his brothers." While the identification of the names as those of different individuals is still widely accepted, many modern scholars, sensible of the Biblical confusion in the antediluvian genealogies, believe that the traditions connected with each one relate to a mythical origin of the Canaanites.

**CAINE, SIR THOMAS HENRY HALL** (1853-1931), English novelist and playwright, was born at Runcorn, Cheshire, May 14, 1853. He was educated on the Isle of Man, and though trained as an architect, he became a journalist, and wrote for the Liverpool *Mercury* for six years. Invited by DANTE GABRIEL ROSSETTI to come to London, he stayed with the poet for some time, and his *Recollections of Rossetti* was published in 1882. It was his remarkable series of melodramatic novels which made Hall Caine famous. Among the best known are *The Shadow of a Crime*, 1885; *The Deemster*, 1887; *The Manxman*, 1894; *The Christian*, 1897; *The Eternal City*, 1901; *The Prodigal Son*, 1904; *The Woman of Knockaloe*, 1923. Several of these were successfully dramatized. Caine died on the Isle of Man, Aug. 31, 1931.

**CAIRNGORM.** See QUARTZ.

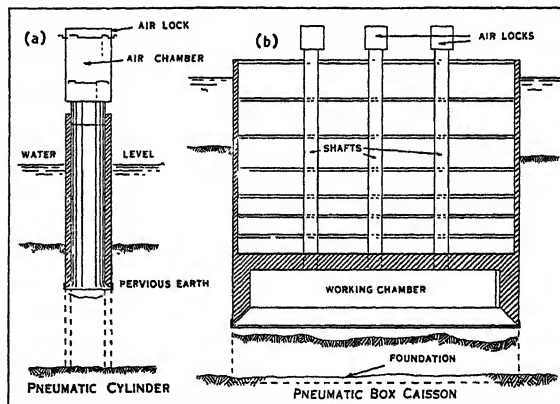
**CAIRO**, the capital of modern Egypt, situated on the Nile, about 100 mi. from its mouth in the Mediterranean Sea, and 150 mi. by rail from Alexandria. Partly surrounded by a fortified wall, Cairo is a city of contrasts where East meets West, and caravan and camel meet the railroad. The modern part has wide streets and great hotels; it stands beside the native town of the narrow lanes and crowded bazaars. The citadel, built on a spur of the Mokattam Hills, contains a well 270 ft. deep called St. Joseph's Well, the palace of the viceroy and several mosques. For thousands of years Cairo or its immediate neighborhood has been the largest city in Africa, for although modern Cairo was only founded in the 7th century, the old city of Memphis adjoins it.

Cairo is essentially a market, commercial and capital city, with a number of well-established industries. There are about 400 mosques, 40 Christian churches, Jewish synagogues and many educational institutions, including one of the oldest universities in the world. The tombs of the caliphs are just outside the city. Pop. 1927, 1,064,567.

**CAIRO**, a city of southern Illinois and port of entry at the confluence of the Ohio and Mississippi

ivers, 150 mi. southeast of St. Louis, Mo., the county seat of Alexander Co. It is a shipping center both for water and rail, being served by numerous railroad, steamboat and ferry lines and is ideally situated at the junction of three states, Missouri, Illinois and Kentucky. Grain elevators and cottonseed oil, flour and sawmills handle the agricultural produce and lumber of the Mississippi Valley, especially of the fertile "Egypt" area of southern Illinois. In 1929 the factory output was worth about \$6,000,000; the retail trade amounted to \$6,329,519. The construction of levees for the city's protection was begun in 1857 and appropriations for repairs and additional levees were made in 1913. From 1928 to 1931 the levees were further enlarged to conform to the standard established by United States Army engineers. When the floods of 1927 affected the valley region, Cairo was immune. The Mississippi is crossed at Cairo by a vehicle bridge constructed at a cost of \$3,100,000. During the Civil War, Cairo was a Federal base of supply where Gen. U. S. Grant had his headquarters (Sept. 1861-Apr. 1862). Ft. Defiance was erected on the site of an early French fort and trading post. Over 45,000 Confederate soldiers were conveyed to points north through Cairo. Thebes, about 25 mi. northwest, and Cairo furnished most of the material for Edna Ferber's novel, *Show Boat*. The first permanent settlement at Cairo was established about 1855, and the city charter was granted in 1857. Pop. 1920, 15,203; 1930, 13,532.

**CAISSON**, a strong, water-tight box or cylinder, in which work is conducted below water level. *Open caissons* are used under conditions where they may be sunk without using air pressure to exclude water. *Pneumatic or compressed air caissons* have an air



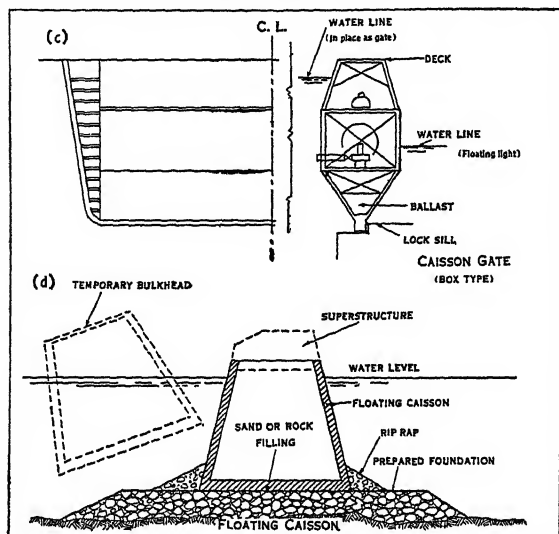
PNEUMATIC CAISSONS

- (a) Cylindrical form is forced into the earth as excavation is made at bottom, the air pressure within the cylinder preventing the entrance of water  
 (b) Box caisson with three shafts through which workmen enter the working chamber to excavate as caisson is sunk and to prepare foundation

tight chamber open at the bottom and fitted at the top with compressed air valves and air locks to permit entrance of air, men and materials. The air pressure increases at the rate of approximately  $\frac{1}{2}$  lb. per ft. of depth. (See CAISSON DISEASE.) The meth-

ods of sinking are excavation and weighting. *Floating Caissons* are floating boxes, sunk into place on a prepared foundation and usually filled with stone or other suitable material, or in which a masonry pier is built as the box sink. They are used in building piers for the support of bridges, wharves, or QUAY WALLS and BREAKWATERS.

Air tight chambers used to raise sunken vessels are also called *caissons*. Floating gates used to close



CAISSONS

(c) Half elevation and cross-section of caisson gate for closing entrance to dry dock or lock

(d) Floating caisson sunk onto a prepared foundation to form breakwater or jetty

the entrances of dry docks or locks are called *caisson gates*.

Caissons are constructed to suit special purposes and conditions. They may vary from cylinders a few feet in diameter of steel, reinforced concrete or timber, to complicated structures of similar materials, but large enough to form the foundation for a pier or abutment of a bridge. They may form a part of the completed structure or the structure may be built inside of them.

F. R. H.

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**CAISSON DISEASE**, a condition occurring in individuals who work in a CAISSON or other places under high air pressure. The symptoms are headache, pain in the abdomen and extremities, dizziness, shortness of breath, coughing, vomiting and paralysis when they return too suddenly to the normal air pressure. The cause of the condition is the saturation with nitrogen of the blood which passes through the lungs during compression. This excess of nitrogen is carried to the tissues, until the whole body is saturated. The presence of this nitrogen excess is harmless until decompression takes place and the oxygen begins to dissolve out of the tissues. If this occurs too rapidly, it causes air embolism, or air bubbles in the tissues, particularly in the veins, adipose tissue, joints and spinal cord, and in the pulmonary circulation.

Prevention consists in gradual decompression when coming out of the caisson. The treatment, when the symptoms have appeared, consists in immediate recompression, by return to the caisson, and the proper supply of oxygen. See also SUBMARINE DIVING. W. I. F.

**CAIUS** or **GAIUS, ST.** (?-296), a bishop of Rome, was born in Dalmatia, the son of Gaius of Concordia. He lived in a time of freedom from persecution and was not a martyr. Tradition records that his bishopric lasted from Dec. 17, 283, until his death, Apr. 22, 296.

**CAIUS, JOHN** (1510-73), English physician and educator, was born at Norwich, Oct. 6, 1510. He graduated from Gonville Hall, Cambridge, in 1532 or 1533 and from 1539-43 studied medicine at the University of Padua. Shortly after his return to England he was made president of the College of Physicians, and was also physician to Edward VI, Queen Mary and Elizabeth. It is, however, for his reestablishment of Gonville Hall that Caius is best known. In 1557 he obtained a charter for a new incorporation under the name of Gonville and Caius College and he endowed it with both land and money. He became the master of the college in 1559, serving until 1573. Caius died at London, July 29, 1573.

See "Life of John Caius" in J. Venn, *Caius College*, 1901.

**CAJORI, FLORIAN** (1859-1930), Swiss-American mathematician, was born at St. Aignan, near Thusia, Switzerland, Feb. 28, 1859. When he was 16 years of age he went to the United States and was graduated from the University of Wisconsin in 1883. Later he studied at Johns Hopkins and received the doctorate from Tulane in 1894. From 1885 to 1888 he taught mathematics at Tulane and from 1889 to 1918 was at Colorado College, becoming dean of the Engineering School there in 1903. He was among those who migrated to the University of California, and from 1918 to 1929 was professor of the history of mathematics in that institution. His chief contributions have been in the history of mathematics, in which field he wrote voluminously. He died Aug. 14, 1930.

### CALABASH TREE

(*Crescentia Cujeta*), a spreading tree of the bignonia family, allied to the CATALPA, native to tropical America and cultivated for its gourd-like fruit, especially in the West Indies. It grows about 30 ft. high, bearing stiff, scarcely divided, horizontal branches, glossy green leaves, and yellowish flowers marked with red and purple. The large globular or oval fruits, have a hard woody shell, which is used for basins, cups, spoons, pails and water-bottles, serving in the place of pottery.



P. A. RYDBERG, "FLORA OF PRAIRIES AND PLAINS"

CALABAZILLA

**CALABAZILLA** (*Cucurbita foetidissima*), a long-running, ill-scented perennial of the gourd family, called also Chile coyote, sometimes grown as a cover vine. It is found wild in sandy soils from Nebraska to Mexico and westward to California. The stems, which grow 5 to 15 ft. long and root at the joints, bear large, heart-shaped leaves and showy yellow flowers produced singly in the leaf axils. The inedible fruit, a smooth, yellow, globular gourd, 3 to 4 in. in diameter, is sometimes called mock orange. The roots were formerly used by the Spanish Californians as a substitute for soap.

**CALAIS**, a city and seaport in the department of Pas-de-Calais, northern France, situated on Dover Straits, about 186 mi. north of Paris. Calais occupies a strategic position, being only 18 mi. from Dover, England. The city was held by the English from 1347 to 1558. In recent years it has been important as a center of traffic, especially passenger travel, between England and France. During the World War it was virtually turned over to Great Britain as a disembarkation port. Besides shipping and fishing, the chief local industry is lace-making. Pop. 1931, 70,213.

**CALAIS**, a city on the northeastern boundary of Maine, in Washington Co. It is situated at the head of navigation on the St. Croix River, opposite St. Stephen, New Brunswick, Canada. Steamships and the Maine Central Railroad serve the city. Bridges connect it with St. Stephen and Milltown. The city is a tourist and trade center for eastern Maine. Dairying, poultry-raising and berrying are important interests in this region. Calais has blueberry canneries and shoe and box factories. Red granite is quarried in the vicinity. The first permanent settlers were lumbermen who came in 1778. The sawmill industry began in 1802, and a charter was granted to the city in 1851. Pop. 1920, 6,084; 1930, 5,470.

**CALAIS, SIEGE OF**, July 1346, a British action against the French seaport on the Strait of Dover, launched by Edward III. Edward began his French excursion of that year with a plundering expedition into Normandy, then returned to the outskirts of Calais, where he laid siege. Despite the suffering of the besieged, the French king, Philip VI, declined to engage Edward's forces, and Calais fell in 1347. The British monarch was dissuaded by his men from putting the inhabitants to the sword, and his Queen Philippa interceded for the lives of six emaciated citizens who, with ropes around their necks, offered their lives to Edward in return for those of the survivors in Calais. The English held Calais for more than 200 years, until the Duke de Guise in 1558 laid siege to the British, who capitulated after six days' fighting.

**CALAMINE**, an ORE of zinc commonly found near the surface as an alteration product of pre-existing zinc minerals, usually with the zinc carbonate, SMITHSONITE. Calamine, the hydrous silicate of zinc, is transparent to opaque, and white, colorless, yellow or brown. It usually occurs in association with the

sulphides of zinc, iron and lead occurring in limestones, as coatings, in mammillary or stalactitic forms, massive, and in orthorhombic crystals. It is mined in Virginia, Tennessee and in Belgium and Silesia. See also ORE DEPOSITS; ORTHORHOMBIC SYSTEM; STALACTITE.

**CALAMITES**, the giant Paleozoic representatives of modern horsetails, ranking among the commonest and most successful plants of the Coal Measures. Trees in size, probably reaching a height of 100 ft. and a diameter of 2 to 3 ft., they grew in dense thickets resembling southern canebrakes. They branched, bottle-brush fashion, like living horsetails. The leaves, very narrow in some species, broader in *Annularia*, also grew in whorls at the joints of the conspicuously ribbed, hollow stems. Some of the branches were tipped by slender cones a foot or more long. Unlike living horsetails, a few Calamites developed spores of both sexes on the same cone. Because of these and other divergences, Scott questions whether they stand in the direct line of descent of recent horsetails. See Equisetites.

**CALANDO**, an Italian musical term meaning "dying away," and synonymous with *decrescendo* except that speed and volume are both diminished. It is one of many similar Italian terms in musical EXPRESSION.

**CALAVERAS DAM**, located on Calaveras Creek, 12 miles from San Jose, Cal. This earth dam is 220 feet high above foundation rock and 205 feet above the bed of the stream. The volume of the dam is 3,461,000 cubic yards and it creates a water supply reservoir for San Francisco of more than 4 billion cubic feet capacity. The spillway is a concrete lined channel adjacent to one end of the dam.

**CALAVERITE**, a pale yellow to white metallic mineral, consisting of gold and tellurium. It often contains some silver and serves as a rare but valuable ORE of gold and silver. See also TELLURIDE; ORE DEPOSITS.

**CALCANDO**, an Italian term used in musical EXPRESSION, synonymous with *accelerando* and *piu mosso*, calling for an acceleration of the tempo.

**CALCEOLARIA**, a large genus of plants of the FIGWORT family, containing some 200 species, from several of which are derived florists' varieties grown for ornament. They comprise shrubs and herbs, native chiefly to Mexico and South America, bearing showy, oddly-shaped, usually yellow or purple, often spotted blossoms. The conspicuously inflated lower lip of the corolla somewhat resembles that of the lady-slipper.

**CALCHAQUI** (Diaguitan), an extinct linguistic stock of South American Indians who inhabited the "Calchaquita valleys" on the eastern slope of the Andes in the northwestern part of what is now the Argentine Republic. They were one of the few peoples who came under INCA influence but yet managed to maintain political independence and to retain a semblance of a distinct and characteristic civilization. Despite an aggressive and warlike nature, the Calcha-

qui were sedentary agriculturists. Their villages, situated on high plateaus which were easily defended, were composed of communal dwellings built of adobe. At one time this stock may have extended westward to the Pacific.

**CALCHAS**, son of Thestor, was the wisest of the soothsayers accompanying the Greeks to Troy. He prophesied the length of the Trojan war. At his advice the wooden horse was built.

**CALCINATION**, heating a solid without melting it, to a comparatively high temperature in contact with air or hot furnace gases. Usually, calcination is accompanied by a chemical change in the calcined material, and a gas, such as water vapor or carbon dioxide, is evolved. Examples of calcination are: the breaking down of limestone into gaseous carbon dioxide and quick lime in the lime kiln; the complete driving off of the chemically combined water by the calcination of gypsum in the manufacture of certain gypsum plasters; and the firing of clay in the manufacture of bricks, tile, and other ceramic products. *See also* KILNS.

**CALCITE**, the most abundant mineral in nature, next to quartz. It occurs in crystals, in massive, concretionary and earthy forms, and enters into the composition of most bones, teeth and shells. When pure, calcite is white or in colorless crystals, but it may be almost any shade or color, due to impurities, and varies from transparent to opaque. Chemically it is calcium carbonate, crystallizing in the rhombohedral division of the **HEXAGONAL SYSTEM**.

Fine, transparent crystals are found in Iceland and are called Iceland spar, which is used in certain optical instruments because of its property of double refraction. Calcite is a common **GANGUE** mineral of most ore deposits, where it is usually crystalline. Deposited from circulating ground waters, it forms travertine and Mexican **ONYX**, which are used in building, and forms **STALACTITES** and **STALAGMITES** in such caves as the Mammoth of Kentucky and the Carlsbad Caverns of New Mexico.

The commonest occurrence of calcite is in **LIME-STONE**, one of the most abundant rocks of the earth's surface, and **CHALK**. It is ordinarily the accumulated shells and skeletons of many species of algae, coral, bryozoa, molluscs, clams and crustaceans, although chemically deposited varieties are known. **MARBLE** is limestone recrystallized by heat and pressure within the earth's crust. These rocks have wide applications in building, sculpture, in the manufacture of cement, fertilizers, crayons, whiting, whitewash, and in metallurgy. *See also* **TRAVERTINE**; **ALABASTER**; **SATIN SPAR**; **DOLOMITE**; **MARL**; **OOHITE**; **SAND**; **SANDSTONE**; **ORE DEPOSITS**; **CONCRETION**; **TUFA**; **SIDERITE**.

**CALCIUM**, a silvery white crystalline metal (symbol, Ca.). It is ductile and malleable; at. wt., 40.07; sp. gr., 1.59; melting point, 780° C.; it oxidizes readily in moist air. Calcium is found only in compounds. Its carbonate occurs in chalk, marble, calcite and aragonites; its sulphate as alabaster, anhydrite, gypsum and selenite; its phosphate in bones. Calcium is pro-

duced by electrolyzing melted calcium chloride in a graphite crucible.

**Medical Aspects.** Calcium is a necessary ingredient of all living cells, as well as of the fluid surrounding them. Without it, potassium and magnesium, also necessarily present in the circumambient fluid, are highly toxic to the cells. No muscular, nerve or gland function can go on without it. It is required for proper clotting of blood and in the curdling of milk. It is also the element that imparts hardness to our bones.

The remedial value of calcium is, however, slight, because an elaborate mechanism exists to maintain the normal calcium level in the system. Absorption of calcium from the bowel is limited by acidity, rather than the amount of calcium present. Giving of large quantities of calcium by mouth does not greatly alter the calcium content of the system. Calcium is useful in a rare condition of bone softening (osteomalacia), due to calcium starvation. It fails in rickets, because this condition is due to deficiency in vitamin D which controls the assimilation of calcium. It favors the clotting of blood when a blood deficiency of calcium exists, as in jaundice. It fails in other forms of bleeding. In tetany, a convulsive condition due to deficiency of calcium, the giving of calcium is second in importance to remedying the cause of the calcium deficiency, which may be, as in rickets, due to the lack of vitamin, or due to lack of secretion of the parathyroid gland, which in some way controls the calcium level in the system. The tendency of calcium to lessen the permeability of blood vessels is made use of in the employment of lime water in skin inflammations and the administration of chalk (calcium carbonate) in diarrheal conditions, in the acid varieties of which the latter is especially efficient by neutralizing acid. *See also* **BONE**; **RICKETS**. B.F.

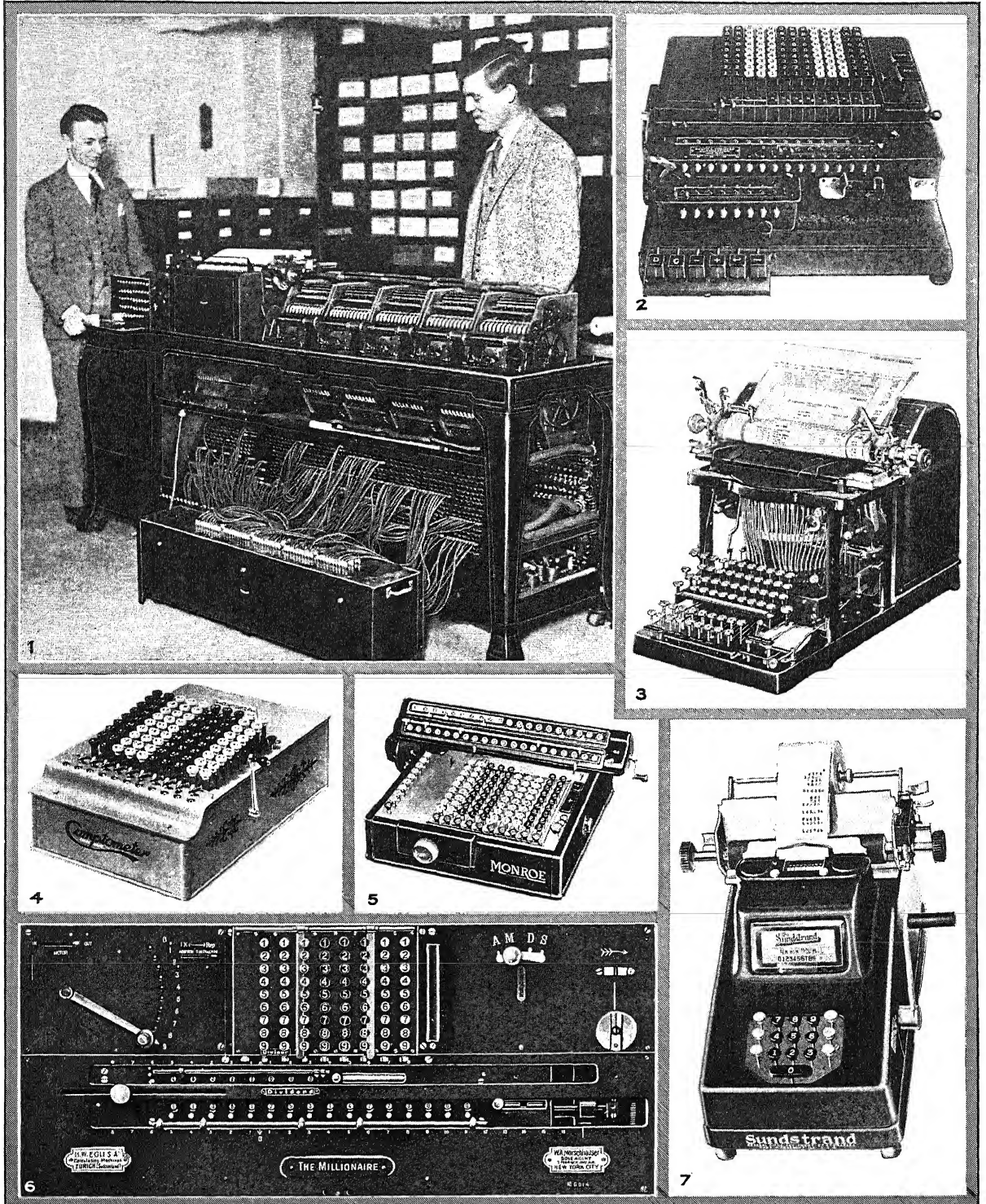
**CALCIUM CARBIDE**, formula,  $\text{CaC}_2$ , is prepared by heating a mixture of pulverized lime and coke in an electric furnace, which, beside calcium carbide, gives off carbon monoxide as a by-product.

One ton of commercial carbide, approximately 80%  $\text{CaC}_2$ , is obtained from a charge consisting of approximately 95 parts lime and 65 parts coke and requires about 2700 kilowatt hours of electric energy. The raw materials should be as low as possible in phosphate, sulphate, magnesia, alumina and silica content.

The furnace is lined with refractory material (*see* **FIRE CLAY BRICK**) and is designed to take a current of 5,000-20,000 kilowatts. The electrodes, suspended through the top of the furnace are made from calcined anthracite coal. The operation of the furnace is continuous, a fresh charge being added to replace the molten carbide drawn off. When cool, carbide is a hard crystalline mass, white when pure, but ordinarily brown, and infusible up to 2300° C. Its specific gravity is 2.22, and it is stable in dry air but decomposed by moisture into calcium hydroxide and acetylene. One pound of pure carbide gives 5.8 cubic feet of acetylene.



## CALCULATING MACHINES



1. COURTESY INTERNATIONAL BUSINESS MACHINES CORP.; 2. RALPH C. COXHEAD CORP.; 3. BURROUGHS ADDING MACHINE CO.; 4. FELT AND TARRANT MANUFACTURING CO.; 5. MONROE CALCULATING MACHINE CO.; 6. WILLIAM A. MORSCHHAUSER; 7. GENERAL OFFICE EQUIPMENT CORP.

## COMMERCIAL CALCULATING MACHINES

1. Mendenhall-Warren-Hollerith tabulator. 2. Full automatic calculating machine. 3. First direct-multiplication listing machine. 4. First key-driven adding machine.

5. First completely automatic calculating machine. 6. First commercial calculating machine to involve direct multiplication. 7. Ten-key adding-listing machine.



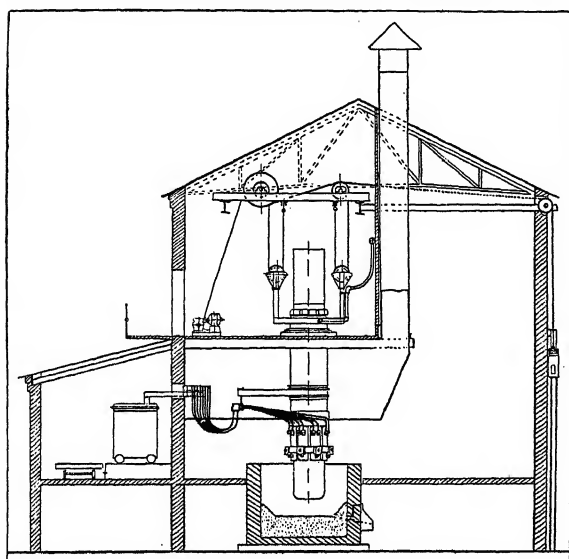


When heated, it reacts with chlorine, sulphur, phosphorus, oxygen and nitrogen.

It is used in the manufacture of CYANAMIDE and ACETYLENE.

K. G. B.; R. N. C.

See R. Taussig, *Die Industrie des Kalziumkarbides*, 1930.



COURTESY DET NORSKE AKTIESELSKAB FOR ELECTROKEMISK INDUSTRI  
CROSS-SECTIONAL VIEW OF THE SODENBERG ELECTRODE FOR PRODUCTION OF CALCIUM CARBIDE

**CALCULATING MACHINES.** Operations with numbers, called calculation, were developed objectively and were so performed until the use of the Hindu-Arabic symbols became widespread. The Salamis table, a cross-ruled slab of marble upon which counters were used; the Roman ABACUS, with its riveted beads sliding in grooves; the Chinese swanpan; the Japanese soroban; the Russian s'choty with beads on rods or wires; and the cross-ruled table upon which casting counters or jetons were used, are all elements in a related series. Pebbles or beads, sometimes on a sanded board, together with the fingers, were the primitive calculating devices.

**First Modern Calculating Machine.** In the process of addition, when the units in any order exceed nine, the registration of one in the next higher order is called carrying. The reverse process in subtraction is called borrowing. The making of this process automatic is the first step toward a modern calculating machine. The first of these calculating machines of which descriptions and models have been preserved was constructed by Pascal (1642). The carry mechanism was a gravity or spring-operated latch. Entries were made in any order but not simultaneously. Subtraction was performed by an ingenious use of co-digits; that is, to subtract 7, or  $10 - 3$ , add 3 and subtract 10.

Leibniz (1671) solved the problem of simultaneous entries in various orders by a tripping device which prepared for the carry but delayed its actuation until the initial additions had been made. This is called delayed carry. The selector mechanism used by Leib-

niz is a set of nine teeth of lengths varying from one unit to nine units, covering approximately one-half the circumference of the shaft. The part of the cycle not so covered was used for the carry. The stepped reckoner of Leibniz has been used continuously since his time in calculating machine design. Hahn adapted (1770-1776) the Leibniz design to a circular form and supplied the expert workmanship lacking in the Leibniz machine. About 1820, Thomas de Colmar began the commercial development of machines of this type, which were further improved by Arthur Burkhardt.

Setting the proper number of pins in operable position by a cam was invented by Baldwin (1872) and by Odhner (1874), although used in earlier models by Poleni and Roth. The Baldwin machine was developed into the Monroe (1913), and the Odhner into the Brunsviga, appearing in variants in the Monopol, Marchant, and many others. A rack-and-pinion selector mechanism was used by Grant (1876) and by Selling (1886). Selling's multiplication device was called the lazy tongs or Nürnberg scissors. An adaptation of the rack-and-pinion in the form of a series of parallel racks was devised by Hamann (1905) in the Mercedes. The upper or lower rack in the series may be held at rest and the others moved through a distance proportional to its position with reference to the rack at rest. If the rack is moved four units with the upper rack at rest, it will move five units with the lower rack at rest. Subtraction is thus performed by adding co-digits.

**Reversible Cycle Machines.** Subtraction is performed on the Thomas type machines by a shift of a pair of opposed bevel gears engaging the recording dials. In such machines the direction of rotation of the main shaft of the machine is the same for addition and subtraction. Machines which reverse the direction of rotation for subtraction are generally known as reversible-cycle machines, as in the Baldwin-Odhner type.

The difference between any number and the next higher power of ten is called the complement of the number. The difference between a number of one order, a digit, and nine is called a co-digit. If, in subtraction, the complement of the subtrahend is added to the minuend, the sum is the same as if the subtraction had been performed, except for the carrying of a ten after the highest order of the subtrahend. This is co-digit addition except for the lowest order, where it is complementary. Many non-reversible cycle machines accomplish subtraction in this way, including the Pascal, Grant, Mercedes, and Comptometer.

The placing of the elements of the machine in operative position and turning the crank to complete the operation is a device due to Leibniz. The common form of setting the numbers by a slide moving in a groove, either a straight line or an arc of a circle, is called the slide set-up. The key-set machine has almost entirely replaced the slide-set in machines made in the United States.

**Key-driven Machines.** If a carry is to be made in any order while the dial is being actuated by an

addition in that order, the dial should respond to being actuated by two sources of motion simultaneously. Leibniz avoided the difficulty by postponing the actual carry. Planetary gears, other forms of differential mechanism, and other mechanical devices have been employed to produce digital actuation and carrying simultaneously. Warren (1875) and Tchebichef (Chebichev, 1882) were apparently the first to construct such a mechanism, each in a single model.

In 1884 Felt began the development of what was to be the first practical key-drive calculator, and which is now known under the trade name of Comptometer. Other such calculators are those of Burroughs and of Turck, the latter being called the Mechanical Accountant.

**Adding and Listing Machines.** The first attempt at recording the result of calculations by printing appears in the works of Barbour and of Baldwin, both in 1872. Both Felt and Burroughs began the active development of such machines in 1888. Paralleling the development of the typewriter, the listing machine was followed by the bookkeeping machine, such as the Moon-Hopkins, Underwood, Elliott-Fisher, Gardner, and others.

**Direct-Multiplication Machines.** In the ordinary calculating machine, multiplication is performed by repeated addition, shifting the carriage from order to order. John Napier (1617) placed the products of the multiplication table on rods, which when properly placed together, enabled the operator to sum up the partial products. Many modifications of Napier's rods have been devised in the attempt to simplify multiplication. In 1872 Barbour, in an incomplete model, transferred the multiplication table to a plate in the form of a series of racks, over which a pinion traveled. In 1878 Vere constructed the first model of a direct multiplication machine of the feeler or finger type. The travel of racks was controlled by taper pins entering holes of different diameters. In 1888 Bollée represented the products of multiplication by pins of varying heights, a device invented independently by Steiger in 1893 in the first commercial machine of this type, the Millionaire.

**Automatic and Power-driven Machines.** Recent developments in the art have been along the line of making completely automatic the processes of multiplication and division and applying power to the machine. The first completely automatic commercial machine was the Mercedes (1921). The first such machine to be developed with complete key operation was the Monroe (1922).

In some key-drive machines the keyboard is shortened from nine keys to five. Nine is registered by pressing the five and four keys successively. The ten-key listing machine as developed by Sundstrand and Dalton enables the operator to cover the keyboard with the ten fingers and makes a touch system possible.

**Difference Engines.** Machines for building up tables from series of differences are called difference engines. The conception of such a machine was due to Charles Babbage (1812). Difference engines have

been built by Babbage (1822), Scheutz (1834), Wiberg (1863), Grant (1875), and Hamann-Peters (1910). Babbage abandoned work on the difference engine to perfect an analytical engine, in which numbers and operations are indicated on punched cards, as designs are indicated on the Jacquard loom.

Machines for calculating correlation coefficients with the Pearson formula have been devised by Dodd at Princeton University, Hull at the University of Wisconsin, and Mendenhall, Warren, and Hollerith at Columbia University. Machines for sorting and tabulating various classes of data are manufactured under the patents of Powers, Hollerith and Bull. Such machines utilize punched cards, as suggested by Babbage for his analytical engine.

**Continuous Calculating Devices.** The slide rule in its various forms is adapted to the solution of problems of a wide variety of types. The representation of the values of a function on a scale by the choice of a suitable unit is allied to the science of NOMOGRAPHY. Two functions which are related in such a manner that the difference between two values of the one is equal to the difference between the two corresponding values of the other, if properly represented on a simple slide rule, will determine any one of four related values if three of them are known. The most common form of slide rule is one in which both functions are logarithmic.

The first to use the logarithmic scale, using a pair of dividers for the transfer of lengths, was Edmund Gunter (1620). In 1621, William Oughtred used two Gunter's lines in the form of slides. The log-log slide rule was devised by Roget in 1814, in which one scale is divided logarithmically and the other proportionally to the logarithm of the logarithm. Such a slide rule is used for involution and evolution.

Slide rules have been constructed in many forms, circular, spirally on a plane, and in the form of a helix on a cylinder. A convenient type of slide rule is enclosed in a case similar to a watch case.

L. L. L.

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**CALCULI**, collections of hard, pebble-like material, which sometimes develop in the gall-bladder and bile ducts; in the pelvis of the kidney, in the ureter, in the bladder; or occasionally in other discharging ducts of the body, such as the ducts from the salivary glands, and the pancreas. They are also found in the prostate gland and in the tonsils.

Except in the case of gall-stones, the stones are usually made up of inorganic matter, often deposited around a minute piece of organic material as a nucleus. See GALL-BLADDER AND BILE PASSAGES, DISEASES OF; UROLOGY: Stone.

**CALCULUS, DIFFERENTIAL and INTEGRAL.** During the second half of the 17th century the British mathematician and physicist Isaac Newton and the German philosopher Leibniz developed a technique for studying magnitudes which are in a state of change. This technique, known as the *calculus*, is fundamental in the applications of mathematics to physics, chemistry, biology and other sciences.

The *differential calculus* is principally concerned with the study of the instantaneous rate of change of a variable quantity. This is important in mechanics, when one investigates the motion of objects acted upon by forces. For instance Newton was able to prove, by his methods, that the orbit of the earth, which he assumed to be acted upon by the gravitational force of the sun, is an ellipse. The notion of instantaneous rate of change also has applications to geometry, for instance, in the construction of tangents to curves.

One of the chief applications of the *integral calculus* is the determination of quantities like volumes of solids, areas of surfaces determined by curves, or the amount of work done in a given process, *e.g.*, in pumping a reservoir full of water.

**Rates.** We shall now briefly study the idea of instantaneous rate of change with the help of the following problem:

A ladder 20 feet long stands vertically against a wall. The lower end is pulled away from the wall, along the ground, at the uniform rate of 2 feet per second, the upper end of the ladder sliding down the wall. How fast is the upper end descending, 6 seconds after the motion of the ladder begins?

At  $x$  seconds after the motion begins, the lower end will be  $2x$  feet from the wall. By the geometry of the right triangle, the height  $y$  of the upper end, above the ground, will be  $y = \sqrt{20^2 - (2x)^2} = \sqrt{400 - 4x^2}$ . A little later, say at  $x + h$  seconds after the motion begins, where  $h$  is a small fraction, the height of the upper end will be  $\sqrt{400 - 4(x + h)^2}$ . If then we represent by  $k$  the distance through which the upper end has dropped during the very small period of  $h$  seconds, we shall have

$$k = \sqrt{400 - 4x^2} - \sqrt{400 - 4(x + h)^2}.$$

If an object moves at a uniform speed over a distance of  $k$  feet during  $h$  seconds, its speed must be  $k/h$  feet per second. In our case, the speed of the upper end of the ladder is not uniform, but if  $h$  is only a small fraction, the variation of the speed during  $h$  seconds will be very slight, so that it will be practical to call  $k/h$  the average speed of the upper end during the  $h$  seconds. Now we have

$$\frac{k}{h} = \frac{\sqrt{400 - 4x^2} - \sqrt{400 - 4(x + h)^2}}{h}.$$

We multiply numerator and denominator in the second member by

$$\sqrt{400 - 4x^2} + \sqrt{400 - 4(x + h)^2},$$

finding that

$$\begin{aligned} \frac{k}{h} &= \frac{4(x + h)^2 - 4x^2}{h[\sqrt{400 - 4x^2} + \sqrt{400 - 4(x + h)^2}]} \\ &= \frac{8x + 4h}{\sqrt{400 - 4x^2} + \sqrt{400 - 4(x + h)^2}} \end{aligned}$$

Now if  $h$  is extremely small,  $4h$  will be extremely small, and  $\sqrt{400 - 4(x + h)^2}$  will be very nearly equal to  $\sqrt{400 - 4x^2}$ . All in all, for  $h$  very small,  $k/h$  will differ only very slightly from  $4x/\sqrt{400 - 4x^2}$ . The latter quantity then is what the average speed comes closer and closer to as we consider smaller and smaller values of  $h$ . On this basis, we take the instantaneous speed of descent as  $4x/\sqrt{400 - 4x^2}$ . At 6 seconds after the motion starts,  $x = 6$ , so that the instantaneous speed of descent is  $1\frac{1}{2}$  feet per second.

**Function and Derivative.** Because the height  $y$ , in the preceding problem, can be calculated when the time  $x$  is known, we call  $y$  a function of  $x$ . In general, when two quantities  $x$  and  $y$  are so related that when the value of  $x$  is given that of  $y$  can be determined,  $y$  is called a function of  $x$ . We symbolize the relation between  $y$  and  $x$ , by writing  $y = f(x)$ . In a definite problem,  $f(x)$  becomes a definite expression; in the above case  $f(x)$  was  $\sqrt{400 - 4x^2}$ . Considering any function,  $y = f(x)$ , and taking some definite value of  $x$ , let us increase  $x$  by an amount  $h$ . Then  $y$  will be changed by an amount  $k$ . For the functions commonly met in mathematics,  $k$  will be very small if  $h$  is very small.

When one considers smaller and smaller values of  $h$ , one finds, as a rule, that  $k/h$  tends toward a definite quantity, such as  $4x/\sqrt{400 - 4x^2}$  above. The quantity which is approached by  $k/h$  as  $h$  decreases is called the derivative of  $y$  with respect to  $x$  for the given value of  $x$ . For each  $x$  there is a derivative. Hence the derivative is a function of  $x$ . The derivative is usually represented by the symbol  $dy/dx$ , which itself does not represent a fraction, but rather a number towards which the fraction  $k/h$  tends as  $h$  decreases. The process of finding a derivative is called differentiation.

**Tangents.** Let us consider the graph, a parabola, of the function  $y = x^2$ , and seek to construct a tangent to it at the point  $(2, 4)$  (Fig. 1). We represent this point by  $P$ . Let  $Q$  be a point on the graph, close to  $P$ . Let  $P$  be joined to  $Q$  by a straight line. We call this line a secant to the parabola.

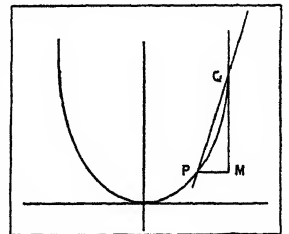


FIG. 1

Let  $2 + h$  be the abscissa of  $Q$ , and  $4 + k$  its ordinate. We have  $4 + k = (2 + h)^2$ , or  $k = 4h + h^2$ , so that  $k/h = 4 + h$ . Now  $k/h$  is the tangent of the angle which  $PQ$  makes with the line  $PM$ . This angle is the same as that between  $PQ$  and the  $x$  axis. As  $Q$

approaches  $P$ , the secant turns, tending towards a line which grazes the parabola at  $P$ , without cutting across it. But when  $Q$  is very close to  $P$ ,  $4 + h$ , which equals  $k/h$ , is practically equal to 4. This means that the trigonometric tangent of the angle between the  $x$  axis and the tangent line at  $P$  is equal to 4. We have thus secured enough knowledge to construct the tangent to the parabola at  $P$ .

We see thus that the slope of the tangent at  $P$ , that is, the tangent of the angle between the tangent line and the positive  $x$  axis, equals the derivative of the function  $x^2$  for the value 2 of  $x$ . In general, the slope of the tangent to the graph of  $y = f(x)$ , at any point, is the derivative of  $f(x)$  for the value of  $x$  which gives that point. Incidentally, the above discussion shows that the derivative of  $x^2$  is  $2x$ .

**Maxima and Minima.** Let it be required to lay out a rope 100 feet long, in a rectangular shape, so as to inclose a rectangle of maximum area. If  $x$  is the length of a rectangle of perimeter 100, the width must be  $50 - x$ . The area  $y$  will be given by

$$y = x(50 - x) = 50x - x^2.$$

Let us imagine that the function  $y$  is graphed. Clearly, at the point on the graph which has the greatest  $y$ , the tangent to the graph is horizontal. This is a geometric counterpart of the physical fact that as one approaches the top of a smooth hill, one finds the hill less and less steep. Immediately before one gets to the top one is ascending; immediately after, one is descending. At the top, one's direction is horizontal.

Thus we have to find a value of  $x$  for which the derivative of  $y$  is zero. Now one finds, by the methods used above, that

$$\frac{dy}{dx} = 50 - 2x,$$

so that, for a maximum,  $x$  must be 25; that is the maximum rectangle is a square.

A similar discussion holds for minima. At those values of a function  $f(x)$  for which  $f(x)$  is either a maximum or a minimum, the derivative is zero.

**Approximate Formulas.** Consider a ring, bounded by two concentric circles, of radii  $x$  and  $x + h$ , where  $h$  is small. The area of the ring will be the amount  $k$  by which the area of a circle of radius  $x$  is increased when the radius is increased by  $h$ .

Now, when  $h$  is small,  $k/h$  is practically the derivative of  $\pi x^2$  with respect to  $x$ , that is  $2\pi x$ . Hence an approximate formula for the area of the ring is  $2\pi xh$ . Similarly, for a spherical shell of inner radius  $x$  and outer radius  $x + h$ , we find the approximation  $4\pi x^2h$ . This method of approximation is continually used in engineering formulas.

**Constants.** We have seen that the derivative of  $x^2$  is  $2x$ . But the functions  $x^2 + 1$ ,  $x^2 + 6$ , in short all functions  $x^2 + c$ , with  $c$  a number, have  $2x$  for derivative. One need only apply the process of differentiation to  $x^2 + c$  to see that  $c$  has no influence on the result. In general,  $f(x)$  and  $f(x) + c$  have the same derivative. Conversely, if a function  $g(x)$  has

the same derivative (for every  $x$ ) as  $f(x)$ , then  $g(x) - f(x)$  is a constant, that is, a number independent of  $x$ ; for the derivative of  $g(x) - f(x)$ , which is easily seen to be the difference between the derivatives of  $g(x)$  and  $f(x)$ , will have a derivative equal to 0 for every  $x$ . Now only a function which does not have the same value for every  $x$  cannot have a derivative which is zero everywhere, for the graph of such a function would have to rise or fall, so that its tangent could not be horizontal everywhere. Then  $g(x) = f(x) + c$ , with  $c$  a constant.

**Integral.** If two functions  $g(x)$  and  $f(x)$  are such that the derivative of  $g(x)$  is  $f(x)$ , then  $g(x)$  is called an integral of  $f(x)$ . For instance  $x^2 + 10$  is an integral of  $2x$ .

For every value of  $c$ ,  $g(x) + c$  will be an integral of  $f(x)$ , and these functions will be the only integrals of  $f(x)$ . It is customary to write  $g(x) = \int f(x) dx$ .

It is easy to prove that if  $n$  is a positive whole number,  $\int x^n dx = \frac{x^{n+1}}{n+1}$ .

**Areas.** Consider the graph of a function  $f(x)$ , as in Fig. 2. For any value of  $x$ , let  $A$  represent the area  $ORPM$  bounded by the graph, the  $y$  axis, the  $x$  axis, and the vertical line which passes through the point  $M$  on the  $x$  axis of abscissa  $x$ .

Evidently  $A$  is a function of  $x$ . When  $x$  is increased by a small quantity  $h$ ,  $A$  is increased by a strip of area  $k$ , which differs only slightly from a rectangle of

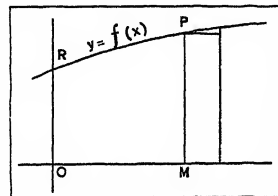


FIG. 2

base  $h$  and altitude  $f(x)$ . In Fig. 2,  $k$  exceeds the rectangle slightly. For a graph which descends as  $x$  increases,  $k$  will be slightly less than the rectangle. But in any case, when  $h$  is very small  $k$  is very finely approximated by  $hf(x)$ , which is the area of the rectangle. Then, for  $h$  very small,  $k/h$  is very close to  $f(x)$ . In short,  $f(x)$  is the derivative of  $A$ . Thus, the area  $A$ , bounded by the parabola in Fig. 1, the positive  $x$  axis and a vertical line of distance  $x$  from the  $y$  axis, has  $2x$  for a derivative. Then  $A$  is an integral of  $x$ . Then  $A = x^2/2 + c$ . To determine  $c$ , we observe that  $A = 0$  when  $x = 0$ . Then  $0 = 0^2/2 + c$ , so that  $c = 0$ . Thus  $A = x^2/2$ .

Let the figure  $ORPM$  in Fig. 2 be rotated about the  $x$  axis. Let  $V$  be the volume of the solid thus generated. If  $x$  is increased by a small  $h$ , the increase  $k$  of  $V$  will differ slightly from a cylinder whose altitude is  $h$  and the radius of whose base is  $f(x)$ . Then, very approximately,  $k = \pi[f(x)]^2h$ , so that, as  $h$  tends toward zero,  $k/h$  tends toward  $\pi[f(x)]^2$ , which is thus equal to  $dV/dx$ . For the parabola,  $V$  is thus an integral of  $\pi x^4$ , and hence  $V = \pi x^5/5 + c$ . As above, we prove that  $c = 0$ .

Let a body, initially at rest, fall under the influence of gravity. After  $x$  seconds its speed will be  $gx$ , where  $g$  is the acceleration of gravity ( $32 \text{ ft./sec}^2$ ). Let  $s$  be the distance through which the body has fallen. Then



$ds/dx$  is the speed. Thus  $ds/dx = gx$ , so that  $s = gx^2/2 + c$ . When  $x = 0$ , we have  $s = 0$ . Hence  $c = 0$ .

**Methods of Differentiation and Integration.** Given the expression for a function, its derivative can be found without difficulty. Thus, the derivative of  $\sin x$ , when  $x$  is measured in radians, is  $\cos x$ . The derivative of  $\log x$ , when the Napierian base ( $e = 2.718 \dots$ ) is used, is  $1/x$ . If  $y$  and  $z$  are functions of  $x$ , the derivative of  $yz$  is  $y \cdot dz/dx + z \cdot dy/dx$ . That of  $y/z$  is  $(z \cdot dy/dx - y \cdot dz/dx)/z^2$ . With these formulas, and others, the most complicated expressions can be differentiated. But it is not so simple a matter to find the integral of an expression. While every differentiation formula implies a corresponding formula of integration, there exist many simple appearing functions whose integrals cannot be expressed in terms of the functions commonly used in mathematical analysis.

J. F. R.

See Osgood, *Elementary Calculus*, 1921; Griffin, *Mathematical Analysis*, 1921.

**CALCULUS OF DIFFERENCES.** That branch of mathematics which deals with successive differences of terms of a series of data taken at regular or irregular intervals. Tables of successive differences enable us to obtain an expression for the particular series in the form

$$y = f(x) = f(a) + x \cdot \Delta f(a) + \frac{x(x-1)}{1 \cdot 2} \Delta^2 f(a) + \frac{x(x-1)(x-2)}{1 \cdot 2 \cdot 3} \Delta^3 f(a) \dots,$$

or the sum of the given number of terms of the series. Calculus of differences is widely used in physics, astronomy and statistics. See INTERPOLATION; EXTRA-

TABLE OF DIFFERENCES

$\Delta$ First diff.	$\Delta^2$ Second diff.	$\Delta^3$ Third diff.	$\Delta^4$ Fourth diff.
a			
b - a			
b	c - 2b + a		
c - b	d - 3c + 3b - a		
c	d - 2c + b	e - 4d + 6c - 4b + a	
d - c	e - 3d + 3c - b		
d	e - 2d + c		
e - d			
e			

**CALCULUS OF VARIATIONS**, a development of the differential and integral calculus. It may be said to have begun with problems requiring the finding of the greatest or least values of a variable, such problems antedating by two centuries the firm establishing of the modern calculus. Newton (1671) asserted that a variable changes from increasing to decreasing, or vice versa when its rate of change is zero, and this determines a maximum or a minimum. Leibniz (1684) stated that this occurred when the tangent to the curve of the function was horizontal, the slope of the tangent then being zero,—analytically the same as Newton's rule. From this beginning de-

veloped such problems as that of finding the curve of least descent (see BRACHISTOCURVE), that of finding a simple closed curve of given length which incloses the largest area, and that of actually proving that a straight line is the shortest path between two points. See MAXIMUM AND MINIMUM VALUES; CALCULUS.

Consult G. A. Bliss, *Calculus of Variations*, 1925.

**CALCUTTA**, the capital of Bengal, India, situated in  $22^\circ 34'$  N. lat. and  $88^\circ 24'$  E. long., on the Hooghly River, a distributory of the Ganges, and covering an area of 32 sq. mi. It is the largest city of India, and, although having only one-sixth the population of Greater London, ranks next to the metropolis in the British Empire. It was the capital of India until 1912, when the government moved to Delhi, but Calcutta still forms the commercial capital of India. Pop. 1921, 1,132,246; 1931, 1,419,321, with suburbs.

A little more than a century ago the site of Calcutta was an unhealthy swamp; it has been made into one of the healthiest cities of India by the labors of man under the direction of the British Indian government. Being situated almost at the limits of the torrid zone and within a degree of the Tropic of Cancer, the climate of Calcutta is less uniform than that of Madras and other places nearer the equator. Three seasons may be distinguished: the hot season, lasting from the middle of March to the setting in of the rains; the rains, which usually set in about the middle of June and last to the beginning of October; and the cold season from November to the early part of March. The average temperature of the whole year is  $77.9^\circ$ ; that of the hot weather months  $85.3^\circ$  (of May  $85.7^\circ$ ), that of the rains  $82.5^\circ$ , and  $68.3^\circ$  in the cold season.

Although 75 mi. from the sea, Calcutta's wharfs are accessible to the largest ocean steamers plying in Indian waters. Dangerous as it is to small craft, the bore which rushes up the river at high tide helps to keep the waterway clear. Very little if any water from the Ganges now flows through the Hooghly, but Calcutta has water communication with the east and north of the delta. A canal plays an important part in this respect and enables raw jute to be sent cheaply to the city's mills. The Hooghly is the westernmost of the important delta channels, consequently railways from the west have no extensive waterways to cross. Hence it is Howrah, on the opposite side of the river, that is the terminus of railways from Delhi, Bombay and Madras. Howrah is connected with Calcutta by the famous "bridge of boats" of which the central boats can be removed at will.

Close to the city are the coal mines of Raniganj and Jherria, and the steel and iron works they support. Howrah, with its big jute mills, manufactures the burlap bags in which so much Indian produce is exported, and also produces sailcloth, ropes and mats.

Calcutta is divided into a European and native city. The European quarter has a Western aspect,

being laid out with fine spacious thoroughfares, some lined with splendid public buildings, including the University of Calcutta, founded 1857. The native city also has well-laid-out streets, and in this respect differs from the aspect of an ordinary Eastern city. The *Maidan* or park has beautiful tropical vegetation and winding waters; here also are Fort William and a race track.

Calcutta was founded by a representative of the British East India Company, and has remained continuously in British possession, except for a few months in 1756-57, when it was captured and sacked by the then ruling native prince of Bengal.

**CALDER, ALEXANDER STIRLING** (1870- ), American sculptor, was born in Philadelphia, Pa., Jan. 11, 1870. He studied at the Pennsylvania Academy of Fine Arts and under HENRI CHAPU and JEAN FALGUIÈRE in Paris. Calder then located in New York, became a National Academician in 1913, and later taught sculpture at the National Academy of Design. His works include statues of Witherspoon, Marcus Whitman and Davies, Presbyterian Building, Philadelphia; a sundial, Fairmount Park, Philadelphia; monumental archways, Throop Institute, Pasadena, Cal.; Washington Group, Washington Arch, New York; and Depew Memorial Fountain, Indianapolis.

**CALDERÓN, SERAFÍN ESTÉBANEZ** (1799-1867), Spanish writer and politician, was born at Malaga, Dec. 27, 1799, of an impoverished noble family. His political adventures resulted in exile, and much misfortune. His eccentric work, *Escenas andaluzas*, 1847, a book of 19 vivid sketches of the locality, eclipsed his recognition for poems and novels, or even his erudite Arabic studies. Dubbed "El Soletario," Estébanez Calderón died at Madrid, Feb. 5, 1867.

**CALDERÓN DE LA BARCA, PÉDRO** (1600-81), Spanish dramatist, was born at Madrid, Jan. 17, 1600. He entered the army in 1635, serving in campaigns in Italy and Flanders. He had already begun to write dramas, and in 1636 King Philip IV summoned him to the court. Under royal auspices Calderón wrote a long succession of plays, and gained a place as the first dramatist of his country and time. He entered the church in 1651 and thereafter confined his playwriting to religious themes. His writings include 122 plays, of which *Life is a Dream* is possibly the best known, and 72 court spectacles of a religious nature. He died at Madrid, May 25, 1681.

**CALDWELL**, a city in southwestern Idaho, the county seat of Canyon Co. It is situated on the Boise River, 30 mi. west of Boise and is served by bus lines and the Union Pacific Railroad. Caldwell is a trade center in a productive irrigated region; the local manufactures are food stuffs. It is the seat of the College of Idaho, founded by Presbyterians in 1893. Caldwell was settled in 1888 and incorporated in 1890. Pop. 1920, 5,106; 1930, 4,974.

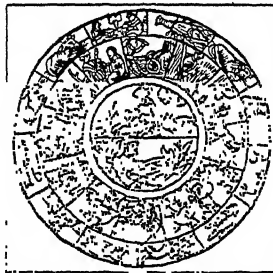
**CALDWELL**, a rapidly growing borough of Essex Co., N.J., situated on the crest of "Second Moun-

tain," a slope forming a part of the Orange Mountains, 18 mi. west of New York City and 8 mi. north-west of Newark, N.J. Its transportation facilities include the Erie Railroad, motor bus lines and electric trolleys. It is strictly a residential community being a popular suburb of Newark and New York City. Pop. 1920, 3,776; 1930, 5,144.

**CALEB**, in Biblical account, a spy sent by Moses to investigate the land of Canaan. He symbolizes the tribe or clan of Caleb, settled in the south of Judah and afterwards merged in Judah.

**CALEDONIA**, the ancient name of the part of Scotland north of the firths of Clyde and Forth, but often applied to all of ancient Scotland. The Romans tried repeatedly to conquer the tribes living in this territory, but they were a fierce people, dwelling in the mountain fastnesses, and even though Agricola had some successes, no lasting impression was made. The Romans also erected walls at different points to keep the Caledonians from making inroads into Britain, but when the legions were withdrawn from the island, these highlanders descended in hordes upon their southern neighbors, causing considerable destruction.

**CALENDAR**, a method of reckoning time, based upon natural divisions and adapted to civil uses and needs. The natural divisions of time are the solar year, or complete cycle of seasons; the month, based on the phases of the moon; and the solar day, or time taken for one revolution of the earth. The month of a certain number of days, the week, and the hour are civil divisions of time. The first calendars were based upon the lunar year of 12 lunar months, or 354 days. Since it did not correspond with the solar year, other calendars were adapted and the civil month substituted for the lunar month.



FROM "THE KALENDAR OF SHEPARGES," PRINTED BY RICHARD PYNSON ABOUT 1497

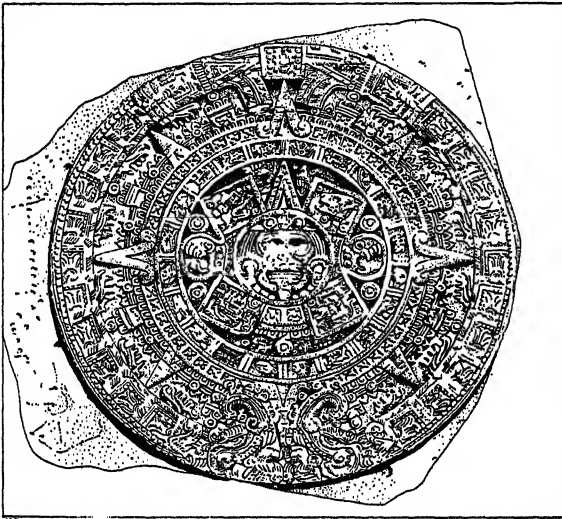
The central circle encloses the symbols for warm weather (a woman with nosegay) and cold (a man by a fire)

In 46 B.C. the Romans adopted the Julian calendar which employed a year of 365¼ days so arranged that the odd quarter day would be compensated for by a whole day every fourth year. The average month was 30 days in length and the extra 5 days was made up by adding a day to certain of them. This year of 365¼ days was longer than the solar year by 11 minutes and 46 seconds, and by 1582 this error had accumulated to 10 days. To compensate for the error the date was advanced 10 days, and it was provided that beginning with 1600 this excess of time, which amounted to about 3 days in 400 years, should be regularly compensated for by making the year coming at the end of every fourth century a common year of 365 days instead of a leap year, thus making the number of intercalary days in 400 years 97 instead of

100. According to this system the difference between the civil calendar and the solar calendar would amount to less than a day in 3000 years. It has been further proposed to correct that error by making the year 4000 and all of its multiples common years instead of leap years. This would reduce the error in the civil reckoning of time to one day in about 200 centuries. Recently there has been considerable agitation for a new calendar having months of 28 days which would cause any one day in the week to fall on the same dates each month. The advantages of such a calendar are internationally recognized and steps are being taken to have it accepted in the leading countries.

The seven-day week, used in most of the civil calendars during the history of the world, had its origin in ancient Asia, and is based on the story of the Creation given in Genesis. Other weeks of four or five days have been used in East African countries, Scandinavia, and other places, and apparently were based upon the time which elapsed between market days.

The more civilized natives of the American continents undoubtedly had systems of reckoning time, as many dates have been discovered, but little is known about their calendars. Of particular interest, however,



COURTESY AMER. MUS. OF NATL. HISTORY

THE FAMOUS CALENDAR STONE OF THE AZTECS  
In the National Museum, Mexico City, Mexico

is the Aztec calendar, a huge circular stone, weighing about 20 tons, on which are carved representations of the history of the development of the world.

**CALENDERING.** See **FINISHING**.

**CALENDULA**, a genus of annual and perennial herbs of the composite family comprising 15 species native to the Mediterranean region from the Canary Islands to Persia, one of which, the **POT MARIGOLD** (*C. officinalis*), is a common flower garden annual.

**CALEXICO**, a port of entry and border city in southern California, located in Imperial Co., 100 mi. east of San Diego, Cal., and served by the San Diego

and Arizona and Southern Pacific railroads. Calexico is a gateway to lower California and Mexico, and is situated in the heart of the **IMPERIAL VALLEY**, which lies partly in Mexico and partly in California. The city is a trade center for a large irrigated region producing melons, lettuce, grape fruit, pecans, cotton, alfalfa, grain and livestock. The principal industries are cotton and cotton-seed oil milling. Mexicali, the Mexican port of entry opposite Calexico, is noted as a pleasure resort, and is the capital of the Northern District of Lower California, Mexico. Pop. 1920, 6,223; 1930, 6,299.

**CALGARY**, a city of Alberta, Canada, situated at an altitude of 3,438 ft., at the confluence of the Bow and Elbow rivers, 175 mi. north of the United States boundary, and 642 mi. east of Vancouver. An important junction of the Canadian Pacific Railway, Calgary lies in the foothills of the Canadian Rockies in the heart of a stock-raising and wheat-growing district. Abundant natural resources of coal and oil, hydroelectric power generated by the Bow and Ghost rivers, and natural gas piped from fields 171 mi. distant, supply the city. Railroad shops, flour mills, oil refineries, meat-packing plants and steel mills are among active industries. Calgary, a well-planned city of fine public buildings, several educational foundations, 25 parks aggregating 751 acres, and a 200-acre airport, was founded in 1876 by the Royal Northwest Mounted Police. In 1881 it contained a Hudson's Bay Company store and the police barracks. The advent of the railroad in 1883 gave it impetus, and it was incorporated as a town in 1884 and as a city in 1893. Pop. 1921, 63,305; 1931, 83,362.

**CALHOUN, JOHN CALDWELL** (1782-1850), American statesman, was born in Abbeville district, S.C., Mar. 18, 1782. After attendance at Waddell's Academy in Georgia, he was admitted to the junior class at Yale, graduating in 1804. He studied law at Litchfield, Conn., and following his admission to the bar at Charleston, S.C., opened a law office at Abbeville. Marriage to a wealthy cousin enabled him to devote himself to politics, and in 1807 he was elected to the South Carolina legislature, serving two terms (1808-09). In 1810 he was elected to the national House of Representatives, serving in that body until 1817. Entering the House, the year before the War of 1812 he was at once recognized as one of the "War Hawks." As acting chairman of the Committee on Foreign Affairs he presented a report to the House, June 3, 1812 recommending war with Great Britain. During the war he worked diligently to provide legislative support for the armies in the field, and after the war he was intensely nationalistic. He favored an adequate army and navy, a national bank, internal improvements at national expense, and a protective tariff. He deplored the growing spirit of sectionalism and assailed "refined arguments" on the Constitution.

In 1817, Calhoun entered Monroe's cabinet as Secretary of War in which capacity he ably served until 1824 when he was one of several candidates for the presidency. The number and strength of his oppo-

nents led him to lower his ambitions to the vice-presidency and to that office he was elected, and re-elected in 1828 on the ticket with Andrew Jackson as presidential nominee. By this time Calhoun had altered his earlier intense nationalism and began to look upon the protective tariff as injurious to his native state. In 1827 he defeated the Woolens Bills by his casting vote in the Senate and in 1828 after the passage of the so-called "Tariff of abominations" his *Exposition on Protest* was anonymously published, its authorship becoming known in 1831. In it he declared the protective tariff unconstitutional and asserted the right of a state to prevent the enforcement within its area of unconstitutional laws. In 1832, the signing of another high tariff bill added fuel to the flames of South Carolinian anger.

In Aug. 1832, Calhoun published his theory that specific powers had been delegated to the general government by the people, and that if these powers were exceeded by the government then the people of the state might by means of a convention declare null and void the legislation which exceeded the entrusted powers. He declared that a court could nullify unconstitutional legislation, but that this power was also retained by the people of the state and could not be withdrawn by the Federal Government. The only recourse of the government in the event of nullified legislation was an amendment to the constitution which would specifically sanction the challenged legislation. Further, according to Calhoun, nullification and secession inhered within the sovereign states, and thereby in important issues necessitated an agreement of the individual states with the government by concurrent majorities. Such in brief were Calhoun's governmental theories which provided logical materials for states rights advocates and united the South against the alleged encroachments of the national government.

Calhoun maintained that his political philosophy was not an assault upon the Constitution but a defense of its original form. In the fall of 1832, when the South Carolina Convention nullified the tariff acts of 1828 and 1832 and enacted laws to enforce the nullification, Robert Y. Hayne resigned from the Senate and assumed the governorship of his state. Calhoun resigned the vice-presidency and was elected to Hayne's place in the Senate in order to defend South Carolina from the floor. At the urging of Calhoun, a second South Carolina Convention in 1833 accepted the Compromise Tariff (1833) and repealed the Nullification Ordinance. Calhoun during the decade of the 1830's followed the southern trend from a defense of slavery to an advocacy of the institution as a positive good. In 1833, he spiritedly debated the merits of slavery with Webster in the Senate. From 1832 until the close of his life (1850) Calhoun was recognized as the spokesman of the South.

Northern opposition to his extreme sectionalism led to an abandonment of his earlier presidential ambitions. He was reelected to the Senate in 1834 and again in 1840. In 1844 he became Tyler's Secretary

of State, and in that office negotiated a treaty with Texas which provided for the annexation of Texas by the United States. It failed of ratification in the Senate. In 1845, he retired to private life but in 1848 when the sectional issue became critical after the Mexican War, Senator Huger of South Carolina resigned his seat to permit Calhoun's election to it. In Jan. 1849 Calhoun issued his *Address to the People of the Southern States* in which he surveyed the course of the slavery controversy, and prophesied with startling accuracy the Civil War and the reconstruction which followed. In Mar. 1850 the great triumvirate of Clay, Webster and Calhoun were for the last time together in the Senate which they had intermittently dominated for a quarter century. Calhoun on Mar. 4, already dying from tuberculosis, huddled motionless in his chair, while his South Carolina colleague Senator Mason read Calhoun's last formal speech in which he lamented the dissolution of the Union unless the North altered its hostility towards the South. On Mar. 31 he died in Washington with his last words reported to have been "The South, the poor South." S. McK.

**CALÍ**, an inland city of Colombia, situated on the River Calí about 180 mi. southwest of the capital, Bogotá. It has an elevation of 3,327 ft. and a healthful climate. Railroads to Popayán, Cortago, Manizales and Buenaventura and 200 mi. of navigable rivers connect it with coast and the interior districts. It is one of the main commercial centers of Colombia. Miguel Lopez Munoz founded Calí in 1533. Pop. 1928, 122,847.

**CALIBAN**, in Shakespeare's *Tempest*, a deformed monster, son of a witch and a devil, originally the proprietor of Prospero's enchanted island, but since charmed into becoming Prospero's servant. 2. The title character in Browning's *Caliban on Setebos*. 3. A philosophical drama by ERNEST RENAN, 1878.

**CALIBER**, the minimum diameter of the bore of a gun (see ARTILLERY) and hence a dimension unaffected by the depth of rifling. Gun lengths are measured differently in different services, but in the U.S. Navy they are taken as the length of the gun-tube measured in calibers, e.g., a 12-in. 50 caliber gun would have a gun-tube 50 feet long; and the total length of the gun would be a little longer, depending upon the length of the screw box.

**CALIBRATION**, the process of correcting the scale of an indicating instrument so that it will give accurate readings. In research work, in particular, it is highly important that all instruments are properly calibrated.

When an instrument has its scale checked to determine whether it correctly expresses the units which it represents, it is said to be calibrated. Thus, a centigrade thermometer, of the mercury-in-glass type has its scale laid off in 100 equal divisions between the boiling and freezing temperatures. If the bore of the tube is uniform it might be assumed to be correct. However, to make sure that the bore is uniform, a column of mercury is detached from the main section

and moved along the tube. If the length of the column of mercury does not remain constant, the bore is not uniform, and corrections must be made on the scale.

**CALICUT**, a city in the Malabar district of Madras, British India, on the Madras railroad. The principal seaport on the Malabar coast, Calicut was once noted for cotton cloth, or calico. Its growth as a city dates from the 7th century, when it became the refuge of the Moplahs, a Mohammedan sect. It was visited by Pero de Covilham in 1486 and by VASCO DA GAMA in 1498, and was ineffectually held by the Portuguese during most of the 16th century. In 1664 the city became a trading post of the English East India Company. The native chief, Hyder Ali, and his son Tippoo warred bitterly for possession from 1765 to 1792, when by treaty Calicut fell to the British. The principal industrial products are cotton goods, tiles, oil and soap. The exports include coffee, tea, copra, coconut oil and spices. Pop. 1921, 82,334.

**CALIFORNIA**, a Pacific Coast state of the United States, popularly known as the "Golden State." It lies between  $32^{\circ} 40'$  and  $42^{\circ}$  N. lat. and  $114^{\circ} 10'$  and  $124^{\circ} 18'$  W. long. On the north it is bounded by



CALIFORNIA STATE SEAL

Oregon, on the east by Nevada and Arizona, on the south by the Mexican territory of Lower California, and on the west by the Pacific Ocean. California comprises an area of 158,297 sq. mi., including 2,645 sq. mi. of water surface. Its extreme length from northwest to southeast is about 750 mi.; its breadth varies from 150 to 350 mi. In area California stands second among the states of the Union.

**Surface Features.** California is divided from west to east into long parallel regions of contrasting topography. There is, successively, the narrow sandy Coastal Plain; the relative low, wooded Coast Ranges; the Great California Valley of remarkable fertility; the Cascade and Sierra Nevada mountains, having some of the grandest scenery and highest peaks in the United States; and, to the east and south, expanses of arid desert. The maximum elevation is Mt. WHITNEY on the boundary between Inyo and Tulare counties, which attains 14,496 ft. above sea level. Sixty miles east of this peak is DEATH VALLEY, 276 ft. below sea level and the lowest point in the state. The total relief is 14,772 ft. and the approximate mean elevation 2,900 ft.

The Great California Valley is about 400 mi. long and averages 50 mi. in width. It is completely enclosed by mountains except for the GOLDEN GATE, a break in the Coast Range. Here the drainage of the valley, concentrated in the Sacramento and San Joaquin rivers, flows in a mile-wide channel to the sea. An

elevation of 400 ft. is maintained generally throughout the 20,000 sq. mi. of the valley although the portion near its outlet is below sea level.

The Coast Ranges form a highland belt at least 50 mi. wide, which extends from the Klamath Range at the northern border to and including the San Rafael Range just north of Los Angeles. They are a series of nearly parallel uplifts, varying from 2,000 to 4,000 ft. in height, with a general trend of north  $30^{\circ}$  west. Thus they end against the coast and their intervening valleys are open to the sea. On the east they rise abruptly from the Great Valley, and on the west decline toward the ocean by broad wave-cut terraces brought about by the intermittent uplift of the mountains. South of Los Angeles the coastal elevations consist of the scattered Angeles Ranges, distinguished by their east and west trend.

The Coastal Plain, a narrow strip of land varying in width from 2 mi. to less than 1, borders the Coast Ranges on the west. At intervals there are long stretches of sandy beach, some of which are noted resorts. The shoreline, measuring 1,264 mi., is indented by bays of which the largest are San Francisco, Monterey, Santa Monica and San Diego.

The Cascade and Sierra Nevada mountain ranges lie east of the Great Valley. The CASCADE MOUNTAINS, extending from the northern border of the state to the 40th parallel, consist of a belt of volcanoes separated by beds of lava and tuff. Between the Pit and Feather rivers there are 120 volcanic peaks in various stages of erosion, including Mt. Lassen, 10,437 ft., which erupted in 1914 and 1915. North of the Pit river the range includes Mt. SHASTA, 14,162 ft., the most prominent volcanic cone in the United States.

Below the 40th parallel the SIERRA NEVADAS begin at heights of 8,000 ft. and extend 400 mi. southward, gradually increasing in altitude. They terminate with the high Sierras containing eleven granitic peaks over 14,000 ft. high. Their eastern slope is one of the steepest on the continent, having a decline of more than 1,000 ft. per mile where the range is highest. The western margin is remarkable for the uniformity of its crest, giving the appearance of a plateau. At the northern extremity of the Sierras, near the Nevada border, is Lake Tahoe, 6,247 ft. above sea level; and about midway the length of the range is the famous Yosemite Valley. Mountain streams dropping over granite ledges into this valley create the highest waterfalls in the United States.

South of the Sierras lies the MOHAVE DESERT, an arid region with an average elevation of 2,000 ft. above sea level. It is spotted with small ranges of wasted mountains separated by basins containing soda or borax lakes. East of the Mohave Desert is a section of the Great Basin extending southward from Nevada. Here are small denuded mountains and low alkali basins, including Death Valley. Owens Lake, the waters of which are bitter with bicarbonate of soda, and Searles Lake, containing extensive potash deposits, are in this region.



Next to the southern boundary, between the coast mountains and the Chocolate Range, is the SALTON SEA or Trough, a basin covering 2,000 sq. mi. which sinks to 273.5 ft. below sea level at its lowest point. Since 1900 this depression has been changed from a salt-caked waste into the IMPERIAL VALLEY, a region of remarkable productivity. The Salton Sea was created in 1904-07 by flood waters of the Colorado River. Since it has no outlet, its original size of 443 sq. mi. has been greatly reduced. It is prevented from disappearing altogether by the inflow of water from the Imperial irrigation canal.

**Climate.** Like that of the entire Pacific coast of the United States, the climate of California differs from the eastern states in the same latitude. The temperature on the whole is much milder and more equable. Furthermore, the average temperatures for summer and winter are nearer the average for the entire year than in the eastern states. San Francisco has a mean annual temperature of 56.1° F. (with an average of 49.9° F. for January and 60.9° F. for September), while that of Los Angeles is 62.4° F. (with an average of 54.6° F. for January and 71.1° F. for August) and of San Diego, 61° F. (with an average of 54.3° F. for January and 68.7° for August). Again, the division of the climatic year into two seasons, wet and dry, is more truly characteristic of California than any adjacent area. The regular seasonal rains invariably occur from about the middle of November until April or sometimes May. Finally, the dryness of the air in summer diminishes to a marked degree the disagreeable effects of high temperatures and even in the hottest of the arid areas, rapid radiation produces cool nights.

Together with the distinctive features which characterize the climate of the state as a whole, there are, however, great variations of local weather due chiefly to difference in altitude and distance from the ocean. The average annual temperature for the state is 57.8° F., but at Indio, below sea level in the Colorado desert, the hottest part of the United States, the yearly average is 73.4° F., while at Twin Lakes, in the high Sierras, the annual mean temperature is 39.1° F. During the period, 1897-1930, the highest temperature recorded in California was 134° F. and the lowest -36°. The average annual precipitation for the state is 25.5 in., but in the northern Sierras the annual mean is 40 in. and in the northwest counties, 60 to 70 in. At Indio, which is situated in the driest part of the United States, the average annual rainfall is 3.7 inches. Death Valley, likewise, is a region of extreme aridity and exceedingly high summer temperature.

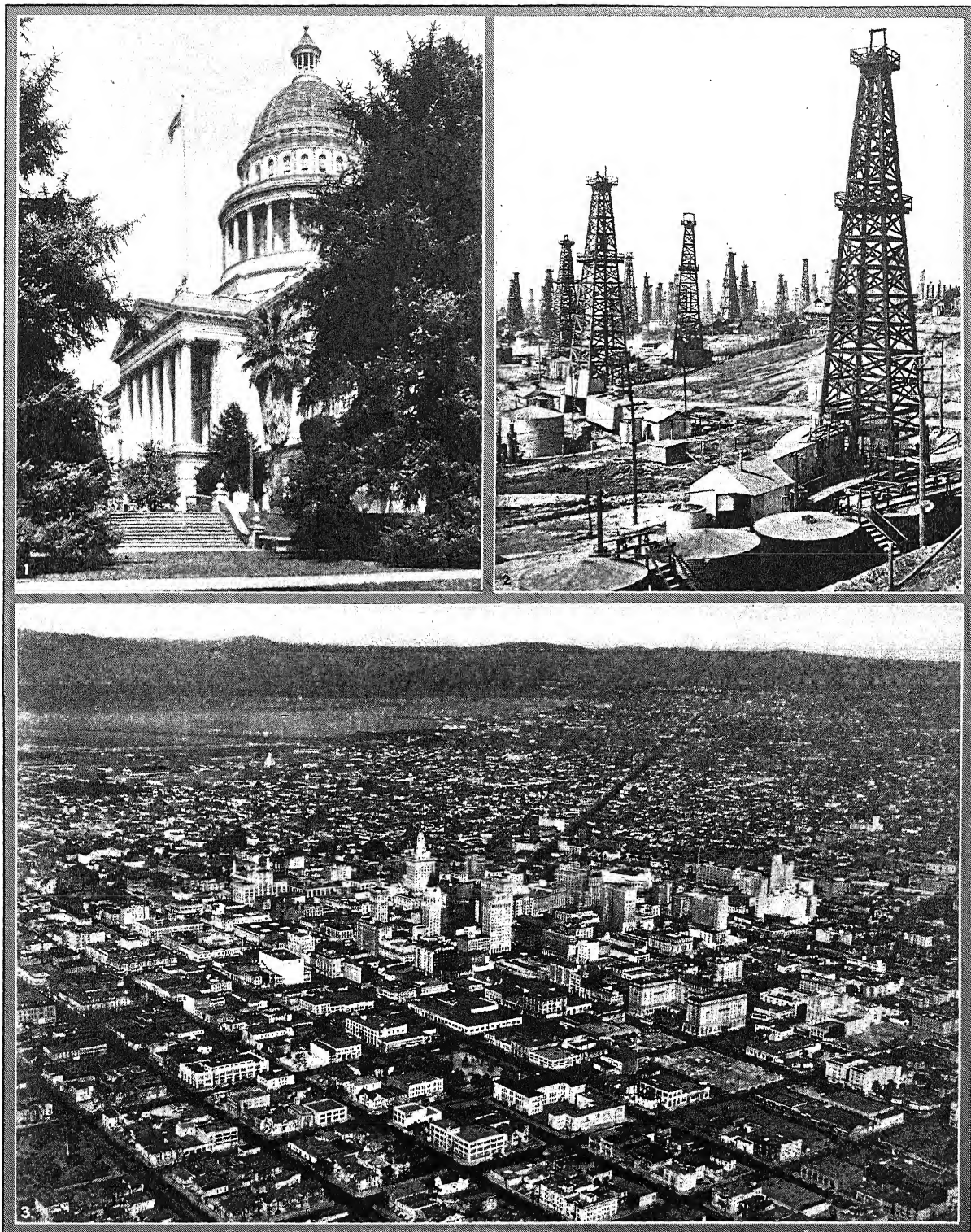
**Forests and Parks.** The most famous forest trees of California are the Redwood, *Sequoia sempervirens*, and the Sequoia, *Sequoia gigantea*. These tremendous trees cover approximately 1,000,000 acres in the Coast Range. Cutting has been and is intensive and is being actively fought by the Save-the-Redwoods League and other organizations. Magnificent virgin stands of redwoods are preserved in four state parks,

the California State Redwood, Humboldt State Redwood, the Henry S. Graves Grove and Bull Creek-Dyerville Forest, a 13,000 stand of the finest of the redwoods, dedicated as a state park Sept. 13, 1931. The bulk of the stands of the Sequoias, frequently called the Big Trees, are preserved in SEQUOIA and GENERAL GRANT NATIONAL PARKS, in Sequoia National Forest and in the Mariposa Grove in YOSEMITE NATIONAL PARK. California's trees vary widely within a given altitude in the northern and southern portions of the state. Regions covered with oaks, juniper, and digger pine merge into yellow pine forests at elevations of approximately 7,000 ft. in the south and 1,000 ft. in the north. The western yellow pine type covers a greater area than any other and forms extensive forests in the lower elevations of the Sierra and Coast ranges. With increased altitude, it is mixed with sugar pine, white fir, Douglas fir, black oak, incense cedar and the sequoias and redwoods. Douglas fir grows in dense pure stands in the coast range in northern California at elevations of 1,000 to 4,000 ft. In the upper portion of this main timber belt are red fir, tamarac, and Jeffrey pine. California and a small part of western Nevada into which California forests extend form the Fifth National Forest district and includes 20 forests with a total net area within California of 19,043,520 acres. The shelters and other recreational facilities of these forests are much used by campers, tourists and the mountain clubs of the state. LASSEN NATIONAL PARK, DEVIL POSTPILE and LAVA BEDS NATIONAL MONUMENTS and extensive state and Federal game preserves are within the national forests. An active State Board of Forestry cooperates with Federal, county and private agencies in the prevention of fire. It also superintends the State Forest Nursery and distributes annually from 40,000 to 60,000 two to three year old trees and several thousand seedlings for reforestation purposes.

The first state park in the Union, now Yosemite National Park, was created in California in 1865. California has eight state parks including in addition to those already mentioned Russ Grove, MOUNT DIABLO, General Bidwell and Burney Falls. The Camp Grounds at Lake Tahoe is classed as a state monument as are the First Theater in Monterey, Fort Ross, an old Russian stronghold, and Mission San Francisco de Solano. See MISSIONS, CALIFORNIA. X.

**Flora.** Physical conditions throughout California vary greatly, producing many different climates, each characterized by its own peculiar flora. The elongated oval of the Great Valley presents a wide plain, treeless save for willows and cottonwoods along its stream borders and valley oak groves on rich loamy deltas. In the rainy season from December to April these great levels support a vast growth of annuals, chiefly of the poppy, pea, sunflower, gilia, phacelia and mustard families, often coloring leagues of the flat lands with golds and blues. The hog wallow lands of the plains furnish winter pools which last from midwinter until late spring, and become zoned with vegetation rings as the water recedes, a zone of blue

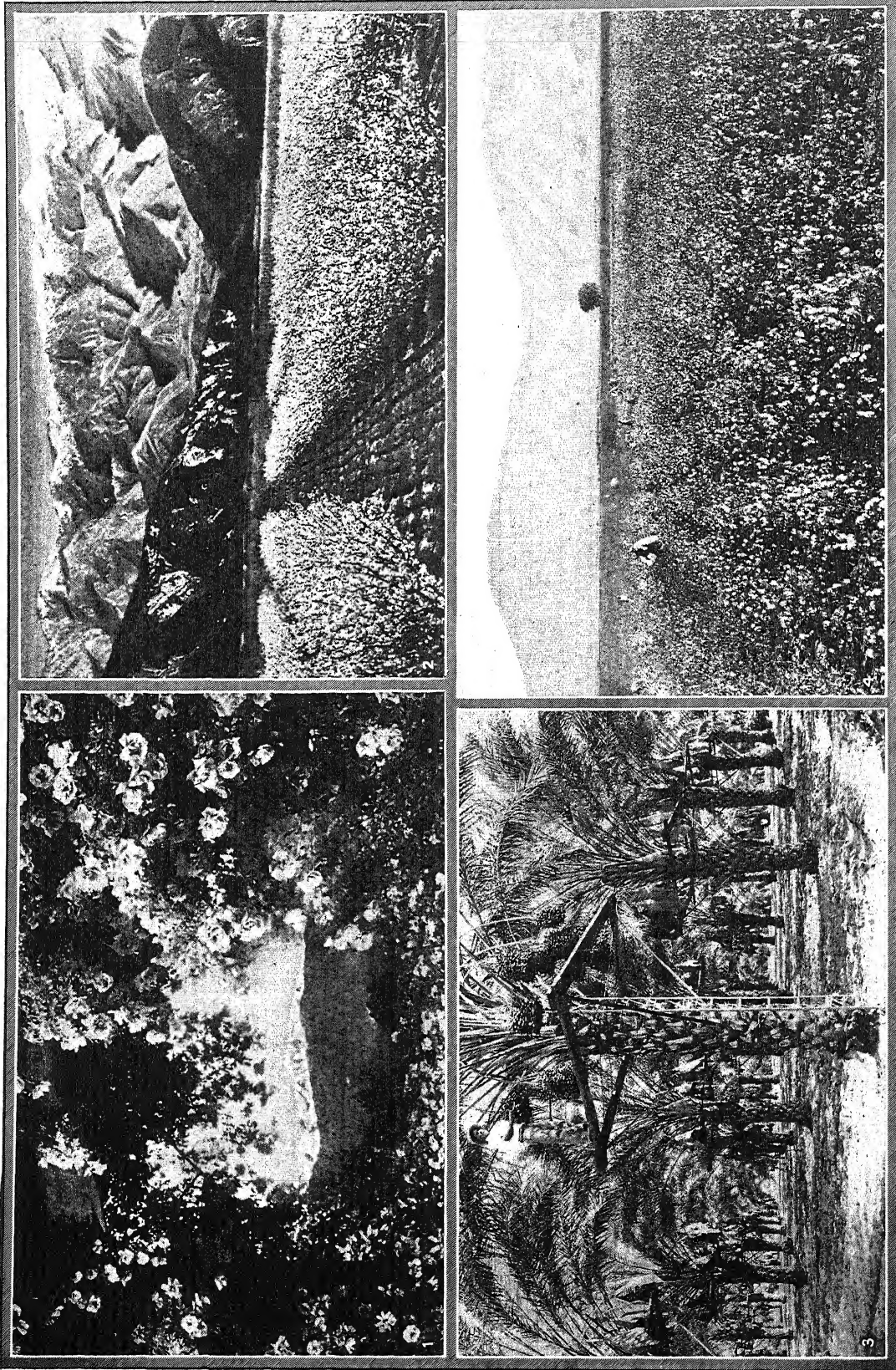
## CALIFORNIA



1. COURTESY SACRAMENTO C. OF C.; 2. LOS ANGELES C. OF C.; 3. U.S. AIR CORPS

### THREE VIEWS OF CALIFORNIA

1. The State Capitol at Sacramento, built in 1860-69.
2. The oil fields at Signal Hill, Los Angeles County.
3. An airplane view of Oakland, across the bay from San Francisco.



1, 2, 3, COURTESY LOS ANGELES CHAMBER OF COMMERCE; 4, KERN CO. C. OF C.

# FRUIT AND COTTON CULTIVATION IN SOUTHERN CALIFORNIA

1. View from the veranda of an orange ranch in Los Angeles County.
2. Almond trees in bloom near Banning, Riverside County.
3. A date-picker at work in Coachella Valley, Riverside County.
4. A second picking of cotton on Barlow Ranch in Kern County.



flowers in April is succeeded by a zone of white in May and finally the zone of duller plants associated with early summer. The plains, after this, for five months are brown and lifeless.

Above the valley floors lie the foothills, either barren or studded with scattered oak or clothed at the higher altitudes with chaparral. Everywhere on the naked hills is poured forth in the spring a flood of flowering herbs, whitening the slopes, or coloring the vales blue. By May the grassy hills are straw-color under the advancing summer sun and above the dry grass rise large numbers of the bulbous-rooted kinds of the lily family, the mariposa lilies with their butterfly-like colors which challenge the traveler as well as a host of varieties of *Brodiaea*. After all these come the tall panicles of the soap root, its bulbs once used by the pioneers as a substitute for soap.

The chaparral is a thorny impenetrable brushland, consisting of many different shrubs, such as buckbrush, MANZANITA and CHAPARRAL PEA, which have taken on a like aspect through similar adaptations to the hard conditions of their arid habitat. With reduced leaves, close-grained wood and short rigid or thorny branchlets they belie their ancestry. Most of them have the power to crown-sprout after the passing of the terrible fires which periodically ravage the chaparral belt, so that this society of plants as primitively constituted, is above all others in California enabled to hold fast to its home territory.

Above the foothill chaparral belt, there is found between 3,000 and 8,000 ft., the forest belt of western yellow pine, California white fir and incense cedar. Associated with this forest are many peculiar flowering shrubs, while the open forest floor is often carpeted for many miles with the low bushes of mountain misery, bearing flowers like those of a strawberry. In this region, too, are wet meadows studded with myriads of herbs, shooting star, five finger, white-head, and corn lily.

Finally, we come to the region above timber line, the alpine zone, 9,000 to 14,500 ft., where dwarf shrubs and dwarf perennial herbs prevail. The alliances of the plants in this area are with the montane regions northward and far north to the Arctic circle, some of them even being circumpolar.

Two striking extremes in the Californian floras are represented by the redwood belt along the north coast and the deserts of the southeastern part of the state. In the redwood belt is found a low story of shrubs consisting of western huckleberry, salal and blue blossom, with a ground cover of herbs showing marked light adaptations in their foliage such as redwood sorrel, deer foot and stink pod. All these herbs, shrubs and trees of the redwood belt in general have large leaves with soft tissues and soft wood. One of the most remarkable of the trees is the great madroño.

In the deserts of the Mohave and Colorado (Salton Basin) the vegetation is xerophytic, characterized by plant bodies reduced and condensed as in the many species of cactus, by leaves which are reduced and thickened as in the mesquite or widespread creosote

bush, or are dispensed with altogether as in the switch plant type, such as the palo verde. These various desert forms are supplemented by such strange growths as the Joshua tree with its few angular arms and tufts of bayonet-like leaves raised high in air, making bizarre shapes on the drear desert levels.

The total native plant population consists of 4,200 species, something over one-third of which are endemic, that is, peculiar to the California area and found not elsewhere in the world. All the areas noted above have their quota of endemics, the alpine having the least. Few other comparable regions on the earth's surface have so rich a flora, few as many endemics. We may compare the flora of Britain with some 1,300 species, none of which are endemics, or the flora of the northeastern United States, a much larger region, which has only 3,500 species and few of them endemics. W.L.J.

**Minerals and Mining.** The development of California's extraordinarily rich mineral resources began with the great gold rush of 1849, stimulated by the discovery of placer deposits at Sutter's Mill, near Coloma, in 1848. Within three years California became the foremost gold-producing region of the world. The output from 1850 to 1860 averaged about \$55,000,000 annually, and the value of the total production to 1870 was fully a billion dollars. With the depletion of the placer deposits and of the more easily worked quartz lodes the gold output steadily declined, touching in 1892 a low point of \$12,000,000, but rising in 1912 to about \$20,000,000 and after the World War entering upon another decline. Yet from 1850 to 1930, with the exception of a few years, California surpassed all other mining states in gold production.

Less dramatic historically but economically far more valuable than the gold output has been the remarkable development of the petroleum industry. The output of petroleum rose from about 4,000,000 bbls. in 1900 to almost 100,000,000 bbls. in 1913 and to nearly 300,000,000 bbls. in 1929, when the value of petroleum and allied products amounted in value to 82% of the total mineral production of the state. California also leads in the output of various other mineral products, notably in mercury and borates.

With mineral productions in 1929 amounting to \$554,916,020, or 10.7% of the total United States output, California stood second among the states, ranking first in gold, mercury, borates, chromite, sodium salts and natural gasoline; second in natural gas, magnesite, pyrites, bromine, silica and cement; third in petroleum; fourth in barite, sixth in salt and seventh in silver and copper.

The outstanding products were petroleum, 292,534,000 bbls., valued at \$321,367,000; natural gas, 342,214,000 M cu. ft., \$68,972,000, and natural gasoline, 840,325,000 gals., \$67,009,000. Among other important products in order of value were cement 12,964,746 bbls. valued at \$22,805,576; clay products, \$22,733,974; building stone, \$10,861,539; gold, 412,479 oz., \$8,526,703; sand and gravel, \$8,371,263; borates,

\$4,515,375; salt, \$2,432,329, and mercury, 770,564 lbs., \$1,238,428.

In 1929 441 mines and quarries gave employment to 9,323 persons who received \$15,278,848 in salaries and wages.

**Soil.** Possessing the greatest area of highly productive irrigated land of any state in the Union, California exhibits also great local diversity in soils. While much land is perhaps forever unreclaimable because of over-ruggedness, elevation or extreme aridity, nevertheless extensive areas have been made available for fruit raising, alfalfa growing, the cultivation of grains, and truck gardening. Throughout the state, sand, in greater or less proportion, prevails as the predominating soil element, found in the lightest loams and also in heavy untractable adobe. Southeastern California possesses the most extensive sandy region. In the northwestern part of the state, however, there are large soil areas made up of volcanic material quite devoid of sand. One of the most fertile soils found in California is the deep rich alluvium of the Imperial Valley, once a part of an ancient delta of the Colorado River.

**Agriculture.** California is preeminently an agricultural state, with vast and varied productions. By reason of marked diversity of soil and climate, linked with intensive cultivation due in part to the development of irrigation, it has become the foremost fruit-growing and vegetable-producing area on the continent.

In 1930 30,442,581 ac. or 30.6% of the entire land area was in farms, 135,676 in number, with an average size per farm of 224.4 ac. and an average value per acre of \$112.33. Of the farm area 8,389,802 ac. or 28% was crop land; 19,990,949 ac. or 66%, pasture land; and 556,749 ac. or 2%, woodland. The total value of farm property was \$3,755,500,079, of which \$3,419,470,764 was represented by land and buildings; \$135,741,365, by implements and machinery; and \$200,287,950, by domestic animals.

According to the census of 1930 California produced in 1929 field, orchard and garden crops amounting to \$537,478,777, ranking second among the states in total value of agricultural productions. The state stood first in the total value of fruits grown for the market and of vegetables harvested for sale. Among temperate-zone fruits, it was first in apricots, cherries, grapes, pears, peaches, plums and prunes, and fifth in blackberries, sixth in apples and raspberries, and ninth in strawberries. Among subtropical fruits and nuts grown California stood first in almonds, avocados, dates, figs, olives, oranges, lemons and prickly pears and walnuts, and second in grapefruit. In the production of market vegetables, the state was first in asparagus, cantaloupes, cauliflower, celery and lettuce; second in beans, peas and tomatoes, third in onions, fourth in cucumbers and watermelons, sixth in cabbage and ninth in sweet corn. California also stood fourth in barley and rice, sixth in hay and sugar beets and eleventh in cotton and cottonseed.

The principal crops produced were fruits and nuts

valued at \$296,241,840; vegetables, \$71,925,812; grains, \$71,819,617; hay and forage, \$66,862,561; cotton and cottonseed, \$26,197,911, and sugar beets, \$3,296,515.

The orchard and bush-fruit crops included apples 145,741 tons, apricots 184,463 tons, cherries 15,235 tons, grapes 1,691,111 tons, peaches 295,180 tons, pears 176,982 tons, and plums and prunes 260,312 tons. The chief subtropical fruits and nuts produced were oranges 43,140,726 boxes, lemons 9,273,923 boxes, grapefruit 1,387,929 boxes, avocados 104,557 boxes, figs 59,313 tons, olives 20,805 tons, dates 1,878,086 lbs., prickly pears 573,958 lbs., almonds 9,389,952 lbs. and walnuts 75,479,128 lbs. Leading small fruits were strawberries 14,971,002 qts., raspberries 2,966,139 qts. and blackberries 2,414,898 qts.

The chief vegetables produced in order of value were: lettuce \$11,489,788, cantaloupes \$9,364,379, potatoes \$9,084,884, asparagus \$7,785,510, celery \$5,752,539, tomatoes \$5,481,070, peas \$2,782,610, onions \$1,830,596, cauliflower \$1,817,701, beans \$1,702,404, carrots, \$1,307,238, cabbage \$978,022, sweet corn \$997,998, and cucumbers \$577,059.

The grains produced in order of yield were barley 29,038,344 bu., wheat 10,957,967 bu., rice 4,968,348 bu., oats 2,162,657 bu. The hay and forage grown amounted to a total of 4,098,993 tons, of which 2,793,820 tons or 68% was alfalfa. Other important crops were cotton, 253,881 bales, and cottonseed, 124,023 tons; and sugar beets 452,818 tons.

The total value of farm products sold by cooperative marketing rose from \$127,990,981 in 1919 to \$153,072,690 in 1929, and farm supplies purchased by this method from \$4,321,129 to \$14,312,161. Farm machinery and equipment in 1930 included 136,842 automobiles, 40,971 motor trucks, 44,437 tractors, 66,260 electric motors, and 32,784 stationary gas engines.

**Irrigation.** The development of irrigation on a scale unapproached elsewhere in America has made California the most highly productive fruit and vegetable region of the continent. In the Census of 1930 irrigation operations are reported for 57 of the 58 counties of the state, the single exception being Del Norte Co. The sections in which irrigation is most extensively developed are the drainage basins of the San Joaquin River and its tributaries; the Sacramento River and its confluent; various streams south of San Francisco Bay, especially the Salinas, Santa Ana, San Gabriel and Los Angeles rivers, and the Colorado River which waters the Imperial Valley.

Although irrigation was established very early in the history of the state its great expansion has taken place since 1890 and especially since 1910. In 1890 there were 13,732 irrigated farms, containing an irrigated area of 1,004,233 ac., served by irrigation enterprises representing an investment of \$13,004,817. The number of irrigated farms grew to 25,675 in 1900, 39,352 in 1910, 67,391 in 1920 and 85,784 in 1930. Similarly the area irrigated expanded to 1,446,114 ac. in 1900, 2,664,104 ac. in 1910, 4,219,040 ac. in 1920 and 4,746,632 ac. in 1930. The amount invested in irrigation enterprises increased to \$19,181,610 in 1900,





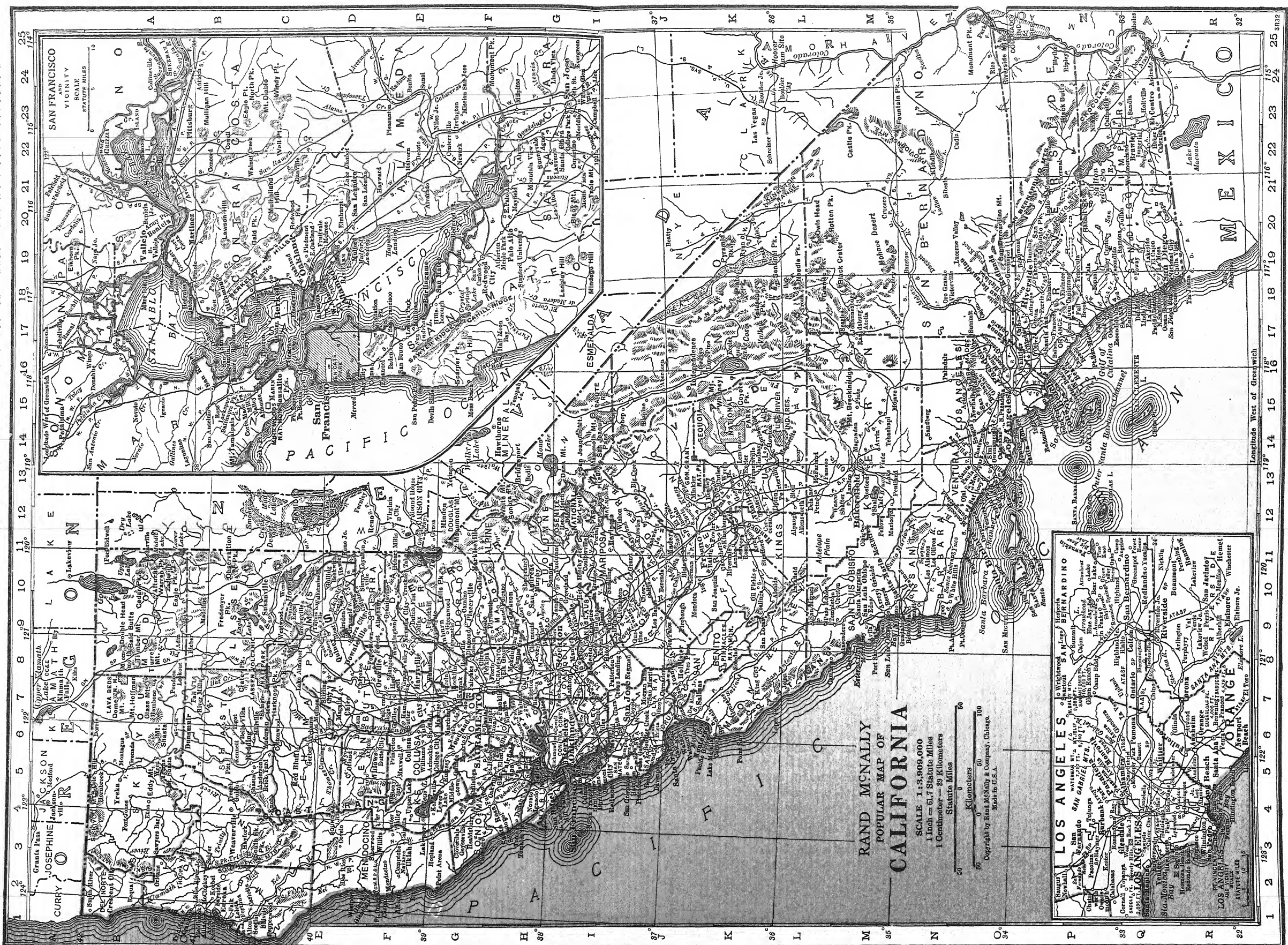
CALIFORNIA

Area 158,297 sq. m.  
Pop. 5,677,251

PRINCIPAL CITIES

Pop.—Thousands

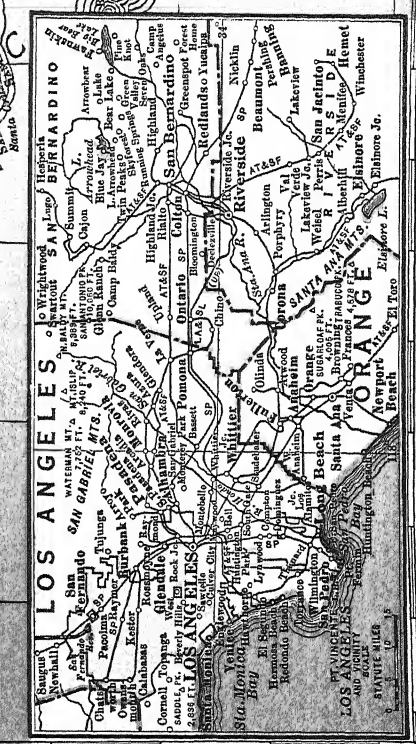
- 35 Alameda... 15
- 9 Albany... 15
- 29 Alhambra... 5
- 11 Anaheim... 5
- 26 Bakersfield... 13
- 8 Bell... 14
- 82 Berkeley... 16
- 17 Beverly Hills... 3
- 10 Brawley... 22
- 17 Burbank... 15
- 13 Burlingame... 15
- 6 Calexico... 22
- 8 Chico... 7
- 8 Colton... 18
- 13 Compton... 4
- 7 Corona... 17
- 6 Culver City... 15
- 6 Daly City... 15
- 6 El Centro... 23
- 16 Eureka... 11
- 53 Fresno... 11
- 11 Fullerton... 16
- 63 Glendale... 15
- 7 Hanford... 12
- 7 Hawthorne... 12
- 6 Hayward... 21
- 25 Huntington Park... 4
- 19 Inglewood... 15
- 8 Lamanda Park (E. Pasadena)... 3
- 7 Lodi... 8
- 142 Long Beach... 15
- 1238 Los Angeles... 15
- 7 Lynwood... 4
- 7 Martinez... 6
- 6 Marysville... 4
- 7 Maywood... 4
- 17 Modesto... 18
- 14 Monterey... 18
- 11 Monrovia... 16
- 9 Monterey... 6
- 6 Napa... 5
- 7 National City... 19
- 284 Oakland... 16
- 14 Ontario... 17
- 6 Orange... 13
- 6 Oxnard... 13
- 6 Pacific Grove... 6
- 14 Palo Alto... 20
- 76 Pasadena... 16
- 8 Petaluma... 14
- 9 Piedmont... 19
- 21 Pittsburg... 23
- 10 Pomona... 17
- 4 Redlands... 18
- 9 Redondo Beach... 15
- 9 Redwood City... 5
- 20 Richmond... 15
- 30 Riverside... 18
- 6 Roseville... 8
- 94 Sacramento... 7
- 10 Salinas... 17
- 27 San Bernardino... 19
- 148 San Diego... 19
- 8 San Fernando... 15
- 634 San Francisco... 15
- 7 San Gabriel... 5
- 58 San Jose... 17
- 11 San Leandro... 7
- 8 San Luis Obispo... 20
- 13 San Mateo... 16
- 3 San Rafael... 14
- 30 Santa Ana... 17
- 34 Santa Barbara... 11
- 6 Santa Clara... 16
- 14 Santa Cruz... 16
- 37 Santa Monica... 14
- 11 Santa Rosa... 14
- 20 South Gate... 14
- 14 S. Pasadena... 15
- 6 South San Francisco... 15
- 48 Stockton... 18
- 7 Torrance... 12
- 6 Tulare... 12
- 14 Vallejo... 19
- 12 Ventura (San Buena Ventura)... 12
- 7 Visalia... 12
- 18 Watsonville... 16
- 15 Whittier... 16
- 6 Woodland... 16



RAND McNALLY  
POPULAR MAP OF  
CALIFORNIA

SCALE 1:3,909,000  
1 inch = 61.7 Statute Miles  
1 Centimeter = 3.9 Kilometers

Statute Miles  
Kilometers  
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\$72,580,030 in 1910, \$194,886,388 in 1920 and \$450,967,979 in 1930.

In 1930 irrigated farms comprised 63% of the number and 71% of the value of all farms in the state. About 56% of all crop land was irrigated. The proportion actually irrigated was 15.6% of all land in farms and 4.8% of the total land area of the state. In value the irrigated farms of California constituted 52% of the total value of all irrigated farms in the United States.

The total number of irrigated farms was 85,784, with an aggregate area of 12,018,864 ac., of which 4,746,632 ac. were irrigated. Including land and buildings the value of all irrigated farms was \$2,438,289,524, or an average of \$202.87 per ac. The total investment in irrigation enterprises to 1930 was \$450,967,979, and the average cost of maintenance and operation for 1929 was \$6.10 per ac.

**Animal Industry.** Cattle-raising, both for milk and beef production, is the chief livestock interest. According to the census of 1930, California stood second in sheep on farms and fifth in pounds of wool shorn; it ranked first in honey and third in chicken eggs produced, fifth in dairy products sold, and eleventh in total value, \$200,287,950, of domestic animals on farms. Among the last named were cattle, 2,101,235, valued at \$126,070,545; sheep, 4,083,728, \$28,874,561; horses, 225,965, \$15,820,234; mules, 40,908, \$3,242,106; swine, 647,791, \$7,675,086; goats, 82,391, \$489,738, and asses and burros, 1,278, \$28,127.

Of the cows on farms, 681,311 were kept mainly for milk production and 420,779 mainly for beef production. In 1929, 445,530,009 gals. of milk were produced; the total value of dairy products marketed was \$95,412,911, including \$76,827,160 for whole milk sold. The value of all poultry raised was \$32,766,768. The number and value of the chief kinds were chickens, 26,644,797, \$27,924,027; turkeys, 1,246,993, \$4,332,157; ducks, 382,810, \$432,318, and geese 35,373, \$78,266. The chickens sold, 13,860,595 in number, were valued at \$14,699,184. Of 159,421,612 doz. chicken eggs produced, valued at \$51,518,531, 141,419,175 doz., with a value of \$45,799,269, were marketed. The sheep industry yielded 18,747,453 lbs. of wool valued at \$5,192,488. Honey, reaching a total of 5,475,818 lbs. valued at \$523,165, was produced from 200,662 hives.

**Manufactures.** During the early period of mining ascendancy manufactures were scarcely attempted, and for many years following the completion of the first continental railroads industry was seriously hindered by want of coal. But, with the development of the state's immense oil fields and the hydro-electric power available in mountain streams, the growth of factory industries has been rapid, the value of their output increasing about 10 times from 1900 to 1930.

According to the Census of 1930 California with manufactures for 1929 valued at \$3,103,349,668 stood eighth among the states. Its 12,019 establishments gave employment to 62,018 officers and employees, who received \$184,048,164 in salaries and to 290,911

wage earners, who were paid \$423,099,248 in wages. These factories used a total of 1,569,086 horse power, expended \$53,725,229 for fuel and power, and \$1,700,433,110 for material and supplies, and added by the process of manufacture \$1,349,191,329 to the value of their output.

This output, which was widely diversified, included about 200 separately enumerated products. The state stood first in the canning and preserving of fruits and vegetables, furnishing about 30% of the entire United States output, and was also first in the production of motion pictures, centered mostly in Hollywood, Los Angeles. California ranked second in petroleum refining and planing mill products; third in cheese and condensed milk production, coffee roasting, and millinery; fourth in electric railway car shop construction and repairs, ship and boat building, and feeds for animals. In such important items as lumber, printing and publishing of newspapers and periodicals, bread and bakery products, women's clothing, fur goods, ice cream and manufactured ice, the state stood fifth. It ranked sixth in the production of motor vehicles, book and job printing, jewelry, beverages and confectionery; seventh in the production of butter, stoves and manufactured gas; eighth in paints, furniture and glass; ninth in foundry and machine shop products, meat packing, motor vehicle bodies and parts, and flour milling, and tenth in iron and steel rolling mill products.

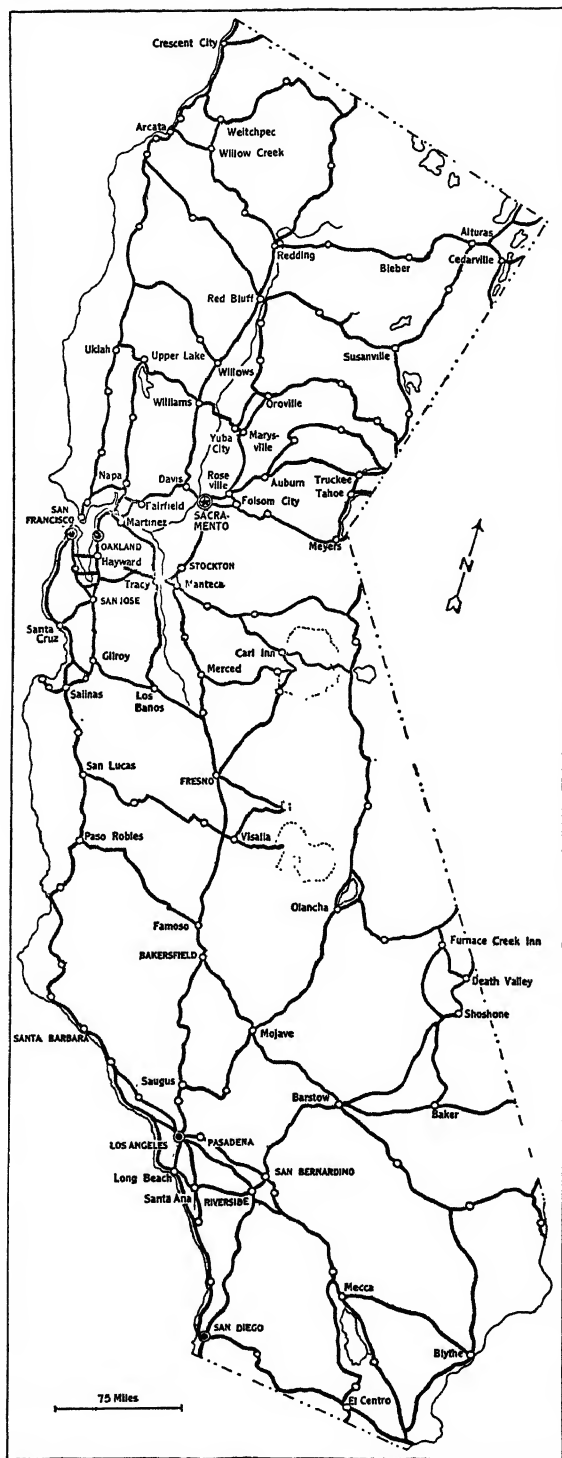
The leading manufacturing industries, which produced about three-fifths of the output of the state, in order of value of products were:

Industry or Product	No. Persons Employed	Value of Products \$
Petroleum refining .....	10,172	484,756,207
Canning and Preserving fruits and vegetables .....	29,888	220,465,391
Meat packing .....	4,924	139,049,822
Motor vehicles .....	6,198	138,316,167
Motion pictures .....	15,169	129,391,172
Foundry and machine shop products.	20,573	121,312,584
Printing and publishing newspapers and periodicals .....	18,205	94,655,488
Bread and bakery products.....	12,599	88,147,253
Lumber and timber products.....	23,228	65,197,608
Rubber tires and inner tubes.....	6,443	56,287,838
Planing mill products.....	8,191	50,562,173
Printing and publishing book and job	8,522	49,321,084
Coffee roasting and grinding.....	1,363	46,874,428
Furniture .....	9,144	44,996,183

The chief manufacturing cities with the value of their output were: Los Angeles, \$745,100,403; San Francisco, \$475,618,387; Oakland, \$218,867,595; Richmond, \$58,869,916; San Jose, \$57,194,419; Long Beach, \$54,676,737, and Sacramento, \$50,045,281.

**Fisheries.** The total fish catch for 1930 was 856,926,000 lbs., valued at \$12,871,000, giving California first place in the country in amount, and third place in value of the catch. The catches of pilchard, tuna and barracuda were the largest in the United States, as was the take of abalone. Other fish important commercially were salmon, cod, striped bass and oysters.





CALIFORNIA STATE ROADS

California is a paradise for sporting fishermen and the tuna fishing off Catalina Island is known all over the world. Other sporting salt water fish include barracuda, swordfish and yellowtail. Inland, the streams and lakes are filled with trout and other game

fish. The state has a far-sighted policy with regard to fish conservation and propagation, and in 1930 spent \$292,000 for this purpose, an amount exceeded only by Michigan. California operates 26 hatcheries with 115 employees and in 1930 put out 35,152,075 trout, 3,545 bass, 65,379 other game fish and 6,269,365 commercial species. It issued 229,374 licenses for which \$469,442 was paid. The United States Bureau of Fisheries planted the following fingerlings and yearlings in 1930: 12,155,000 Chinook salmon; 200,000 steelhead salmon; 20,000 Atlantic salmon; 100,000 rainbow trout and 50,000 Loch Leven trout.

**Transportation.** The only means of transportation available to California after the gold rush of 1849 were clipper ships, steam packets and the Overland Mail Company, subsidiary of Wells-Fargo, which operated a stage line from St. Joseph, Mo. to Sacramento. After 1869, when the first transcontinental railroad was completed by the connection of the Union Pacific and Central Pacific railroads, transportation facilities increased rapidly. On Jan. 1, 1930, the total railway mileage of the state was 8,292, and included, in addition to the systems mentioned above, parts of the Western Pacific, Southern Pacific and Santa Fé systems. The Federal Government has spent large sums in the improvement of the harbors of San Francisco, Los Angeles, San Diego and Oakland, which is in San Francisco Bay. The state and Federal Governments have cooperated in the improvement and extension of the Sacramento, San Joaquin and Feather rivers, the most important navigable waterways.

Since 1919 the highway system has shown rapid improvement. On Jan. 1, 1930, there were 102,345 mi. of highway, of which 25,381 mi. were surfaced roads and 4,255 mi. state highways. The total highway expenditure during 1929 was \$58,254,190, of which the state paid \$28,577,468 and county and local governments \$29,676,722. The state gasoline tax produced a gross revenue of \$34,870,126 during 1930. Motor vehicle registrations during 1930 were 2,041,356, second only to New York, and an increase over 1925 of 600,815 cars, or 42.4%. Motor truck registration increased from 214,745 to 230,387 in the same period, while the number of buses in operation went from 3,361 in 1925 to 4,349 in 1930.

**Commerce.** According to the census of 1930, there were in 1929 9,751 wholesaling establishments in California, with total sales of \$4,159,323,157. This volume represented 6% of the total for the United States, and was exceeded in only three states: New York, Illinois and Pennsylvania. These wholesalers gave full-time employment to 123,053 men and women, whose annual salaries aggregated \$219,909,186. Los Angeles and San Francisco, the most important distributing centers, both reported wholesale trade in excess of \$1,000,000,000. Oakland, Sacramento, Fresno, San Diego and San Bernardino were also important.

The total sales of the 86,025 retail stores amounted to \$3,268,545,636. This retail volume was exceeded



only in New York, Pennsylvania and Illinois. Average sales per store, exceeded in only four states, were \$37,995. Sales per capita, however, at \$575.73, were higher than in any other state in the Union.

#### CHIEF RETAIL DISTRIBUTING GROUPS

Group	No. of Stores	Sales	% of Total
Automotive .....	17,862	\$770,095,946	23.56
Food .....	24,063	663,321,579	20.29
General Mdse. ....	2,630	422,295,988	12.92
Apparel .....	6,589	278,128,607	8.51
Lumber & Bldg. ....	4,142	222,661,261	6.81
All other stores ....	30,739	912,042,255	27.91
Total, all stores ...	86,025	\$3,268,545,636	100.00

San Francisco and Los Angeles, the principal ports, handled water-borne commerce valued at \$1,613,104,800 and \$1,088,464,363 respectively. Oakland, with \$326,660,368, was also important. The most important items handled were oil and gasoline, lumber, and fresh fruits and vegetables.

**Finance and Banking.** The assessed value of all real and personal property in California in 1929 was \$9,561,117,856. On June 30, 1930, the state's total bonded debt was \$119,727,000. Total revenue receipts for the year ended June 30, 1928 were \$102,729,699, while total expenses were \$89,031,147. The principal sources of revenue included business and non-business licenses, \$61,637,820, sales tax on gasoline, \$15,447,544, and property taxes, \$19,826,232. The principal expenditures were for education, \$24,109,162, permanent improvements, \$17,216,047, construction and maintenance of highways, \$15,796,198, and debt service, \$4,851,646.

California, now the fifth state in the Union in banking strength, is surpassed only by New York, Pennsylvania, Massachusetts and Illinois. There were 420 banks here in 1930, of which 198 were national banks and 222 trust companies and state banks. These institutions had an aggregate capital of \$228,106,520; their surplus and undivided profits aggregated \$227,387,000. Total resources of all banks amounted to \$2,354,565,000. Total demand deposits were \$1,068,732,000 and time deposits, including postal savings, were \$2,164,767,000. Per capita demand and time deposits in 1930 were \$564.31; per capita savings deposits, \$325.79. Total savings deposits, which amounted to \$1,866,779,000, were owned by 3,330,276 depositors. Total national bank circulation in 1930 was \$39,285,000. Bank clearings for the year ended Sept. 30, 1930 were \$10,297,475,000 in San Francisco, the state's most active banking center.

**Government.** California's law-making power is vested in a general assembly composed of a senate of 40 members and a house of representatives of 80 members meeting in biennial sessions unlimited in duration. Senators are elected for four-year and representatives for two-year terms. The governor, lieutenant governor, secretary of state, comptroller, treasurer, attorney-general and surveyor general compose the executive department. The governor is elected for a term of four years and receives a salary of \$10,-

000 per annum. He has the right of pardon and veto, but a two-thirds vote of each house may override his veto. Judicial power is vested in such inferior courts as the legislature may see fit to establish, in superior courts and in the supreme court, comprised of seven judges elected for terms of 12 years at salaries of \$8,000 per annum.

**Social Welfare Institutions.** Besides state institutions, private institutions for the treatment of the insane are under the California Department of Institutions. The state hospitals for the insane are at Agnew, Talmage, Norwalk, Patton, Stockton and Imola. There is a state school for delinquent boys at Whittier. At Whittier also is the Bureau of Juvenile Research which holds clinics for the examination of "problem" children. The Preston School of Industry at Waterman is for boys between 15 and 21 years of age who have been committed by the courts. An industrial home for the adult blind with workshops for mechanical trades is maintained at Oakland and also an industrial workshop for the blind at Los Angeles. There is a school for delinquent minor girls at Ventura. The Pacific Colony for feeble-minded is situated at Spadra. The Sonoma State Home for feeble-minded at Eldridge has, since 1927, occupied the property formerly used by the Industrial Farm for Women. A colony for male epileptics has been established here also. The State Narcotic Hospital is at Spadra. The state prisons are at San Quentin and at Folsom, post-office Represa. A state parole officer works with the prisoners on parole from these prisons.

**Education.** The first schools were Spanish mission schools established after the settlement in 1767. These provided the sole educational opportunities in the state until in 1847 the town council of San Francisco ordered a small schoolhouse built. School districts were established in 1851. In 1856 a high school was opened in San Francisco. By 1928 there were 6,947 public school buildings in California, with 805,798 pupils enrolled in the public kindergarten and elementary schools, and 199,940 pupils in the public secondary schools. Education is compulsory for children from 8 to 16 years of age for the entire school year. The number of persons from 5 to 20 years of age attending school in 1930 was 1,104,943, or 78.5% of the population within the ages specified, as compared with 579,211, or 69.5%, in 1920. The number of persons 10 years old and over unable to read and write in 1930 was 124,810, or 2.6%, as compared with 95,592, or 3.3%, in 1920.

For higher education the state maintains the University of California at Berkeley and Los Angeles; teachers' colleges at Chico, Arcata, Fresno, San Diego, San Francisco, San José, and Santa Barbara; and a polytechnic school at San Luis Obispo. Outstanding among the many private educational institutions are Leland Stanford University near Palo Alto, the University of Southern California at Los Angeles, Pomona College at Claremont, the California Institute of Technology at Pasadena, and the University of

Redlands at Redlands. The California State Library Commission has headquarters at Sacramento.

**Population.** In 1930 California ranked sixth among the states with a population of 5,677,251 or an average of 36.5 per sq. mi., an increase of 2,250,390 or 65.7% over 1920. This increase was the greatest numerically made by any state during any previous decade. The population rose from 92,597 in 1850 to 1,213,398 in 1890, 1,485,053 in 1900, 2,377,549 in 1910 and to 3,426,861 in 1920. In 1930 there were 5,040,247 or 88.8% whites, 368,013 or 6.5% Mexicans, 97,456 or 1.7% Japanese, 81,048 or 1.4% Negroes, 37,361 or 0.7% Chinese, 30,470 or 0.5% Filipinos, and 19,212 or 0.3% Indians. Of the whites, 4,230,213 were native born and 810,034 were foreign born, an increase in the latter of 128,372 since 1920. Of the total foreign stock, including foreign born and foreign and mixed parentage, 310,409 or 14.7% were German; 236,622 or 11.2%, Italian; 229,602 or 10.9%, English; 201,684 or 9.6%, Canadian, other than French; 148,310 or 7.0%, Irish; 103,603 or 4.9%, Swedish; 97,012 or 4.6%, Russian. The urban population was 4,160,596 or 73.3% of the total, an increase of 1,828,867 or 78.4% from 1920; the rural population was 1,516,655 or 26.7% of the total, an increase of 421,523 or 38.5% since 1920. There were in 1930 five cities of 100,000 and upwards: Los Angeles, 1,238,048; San Francisco, 634,394; Oakland, 284,063; San Diego, 147,995; Long Beach, 142,032.

**Occupations.** In 1930 2,500,644 persons, or 44% of the population, were gainful workers 10 years old or older; 77.7% of these were males and 22.3% were females; 70.9% were native white; 18.5% foreign-born white; 1.7% Negro, and 8.9% other races. Of the females 15 years old or older 41.6% were single, 35.8% were married and 22.6% were widowed or divorced.

Among the principal occupations, with number of workers, were farmers, 126,573, and farm wage workers, 190,022; factory operatives and laborers, 139,779 men and 39,392 women, including 33,222 persons in food industries; sales persons, 117,797 men and 40,251 women; clerks, 87,959 men and 51,877 women; servants, 40,929 men and 61,829 women; retail dealers, 101,734; carpenters, 64,690; building laborers, 60,465; chauffeurs, 53,869; stenographers, 1,842 men and 51,568 women; school teachers, 9,504 men and 41,621 women; bookkeepers and cashiers, 17,640 men and 30,791 women; real estate agents, 28,020 men and 11,387 women; waiters, 13,225 men and 19,370 women; mechanics, 30,091; machinists, 29,086; painters, glaziers and varnishers, 26,580, and barbers and hairdressers, 15,908 men and 9,237 women.

#### HISTORY

Jean Rodriguez Cabrillo and Bartolome Ferrero in 1542-1543 explored the California coast; in 1579 Drake followed the northerly shore; Sebastian Vizcaino carefully explored the bays of San Diego and Monterey, 1602-1603. Yet Spanish colonization did not extend into the present limits of California until

1769, when Junipero Serra founded a Franciscan mission at San Diego. Monterey was occupied in 1770. Spain encouraged the occupation of California as a buffer to Russian encroachments. By 1800 18 missions had been founded, and three were planted later; other military and civilian establishments were founded. The government of the province was administered by a military officer at Monterey. At the close of the mission era in 1834, when the Mexican government began the confiscation of the ecclesiastical properties, over 80,000 Indians had been converted; extensive acreage was given over to wheat and hemp; and the hides and tallow yielded by the herds of livestock about the missions were the staples of foreign trade. Part of the Mexican republic since 1821, California was represented in the Mexican congress after 1824. The secularization of the missions was followed by years of unrest—five governors were deposed, or frightened from office, between 1831 and 1845; by the growth of regional patriotism, and by the penetration of foreign influences—in 1812 a Russian trading post had been founded at Bodega Bay, Jedediah Smith and his fellow trappers, Americans, reached California in 1826 and the HUDSON BAY COMPANY began operations in California in 1830. After 1840 the American element in California received annual additions; foreigners as a class were respected in the practically autonomous province, and some—notably John Sutter, on whose land gold was discovered, Jan. 24, 1848—were granted generous estates. In 1842 Commander T. A. C. Jones of the U.S. Navy prematurely assumed that war had been declared between Mexico and his country, and captured Monterey, October 21, retiring with apologies. The American consul at Monterey was instructed in 1845 to promote the secession of California from Mexico. FRÉMONT, heading an American surveying expedition, by suspicious movements invoked hostilities; he directed the seizure of a band of Mexican cavalry horses and the occupation of Sonoma, June 14, 1846, over which town a "Bear Flag," intended to signalize an independent California, floated for a few days. During the MEXICAN WAR Commodores John Drake Sloat and Richard F. Stockton and Generals Kearny and Frémont easily won California. The TREATY OF GUADALUPE-HIDALGO, 1848, bestowed formal possession on the United States.

The assurance that gold in great quantities existed in California produced electrifying results. The white population of California, about 5,000 in 1845, reached 100,000 in 1850, and after another decade was almost 400,000. San Francisco became a great city with unprecedented suddenness. California was declared a Territory on Aug. 15, 1846. However, its future became involved in the slavery controversy, and California was politically unorganized until on Sept. 9, 1850, she was admitted as a free state. But the slavery issue was not eliminated; the Democratic party in California agitated in its behalf, and the scheme of an independent Pacific Republic, permitting slavery, was considered. When the CIVIL WAR began, the federal

Government, appreciating the delicate situation, exempted California from furnishing troops. But the state proved dependably loyal, and sent five companies of volunteers. Its mineral resources were invaluable to the Union. As the great agricultural possibilities of the state became evident, a second great wave of settlement swept into California, continuing steadily after 1870. Whereas covered wagons, steamship packets, the Pony Express and clipper ships, were characteristic of the gold-seekers' migration, the migration of families made use of the railroad. The Union Pacific, first transcontinental railway, had been completed in 1869, and in 1886 a competing railroad was completed into southern California. A great land boom, in which values in Los Angeles, San Diego and San Bernardino Counties advanced hectically, was maintained for two years and collapsed without endangering the banking system or deflating the value of the most desirable sites. A steady influx of Middle-Westerners seeking comfortable retirement, perennial visitations of vacationists, and the growth of the cinema industry have contributed to the prosperity of the state. Under the leadership of Hiram Johnson, California was a Republican stronghold, but in 1932 gave its 22 electoral votes to Roosevelt. William G. McAdoo, Democrat, was elected senator.

**BIBLIOGRAPHY.**—C. E. Chapman, *A History of California: the Spanish Period*, 1921; R. G. Cleland, *A History of California: the American Period*, 1922; R. E. Cowan, *A Bibliography of California and the Pacific Northwest, 1510-1906*, 1924.

**CALIFORNIA, GULF OF**, an arm of the Pacific Ocean separating the peninsula of Lower California on the west from the states of Sonora and Sinaloa, Mexico, on the east. It is about 739 mi. from northwest to southeast, and its width varies from 50 to 120 mi., giving it an area of 64,000 sq. mi. The coast on both sides is irregular, being indented with many small bays and gulfs, and is fringed with numerous islands. In the southern section the water has a depth of 6,000 ft. but the bottom gradually rises toward the north and ends with the shallows formed by the sediment deposited by the Colorado River, the chief tributary of the gulf. This body of water is noted for its pearl fisheries.

**CALIFORNIA, LOWER.** See LOWER CALIFORNIA.

**CALIFORNIA, UNIVERSITY OF**, at Berkeley, Cal., a coeducational state institution established in 1868, is an outgrowth of the College of California, founded in 1853 at Oakland. In addition to the departments at Berkeley, there is a College of Dentistry, College of Pharmacy, a Law School and a Medical School at San Francisco. In Los Angeles is the Southern Branch of the University, comprising a Teacher's College and a College of Letters and Science. The astronomical department, located in Lick Observatory on Mount Hamilton, contains equipment which, together with its natural advantages, make the observatory one of the great sources of cosmological knowledge. The university had endowment funds totaling \$16,874,000 in 1931. The library of 785,242

volumes is especially rich in material relating to the history of California, Central America and South America. In 1931-32 there were 11,231 students at Berkeley and a faculty of 2,143, headed by Pres. ROBERT GORDON SPROUL.

**CALIFORNIA INSTITUTE OF TECHNOLOGY**, at Pasadena, Cal., a privately controlled, non-sectarian college of science and engineering. An outgrowth of Throop Polytechnic Institute, founded in 1891, it received its present title in 1920. In engineering the four-year undergraduate courses are of a general, fundamental character, with a minimum of specialization; the fifth-year courses lead to the degree of M.Sc. in civil, mechanical, electrical, chemical and aeronautical engineering. The undergraduate courses in science offer intensive training in mathematics, physics, chemistry and biology, also French and German and various cultural studies; the graduate courses lead to the M.Sc. degree in physics, astrophysics, mathematics, chemistry, geology, geophysics, paleontology and biology. Special emphasis is laid on research, for which the institute has remarkable facilities. Between 1926 and 1930 it received endowments from the Daniel Guggenheim Fund for the Promotion of Aeronautics for the establishment of the Graduate School and Laboratory of Aeronautics at Pasadena, and the Airship Institute at Akron, O. There are six departmental libraries and a general library containing 25,000 volumes. The total sum of productive funds is \$9,200,000. In 1930 there was a student enrollment of 668, and a faculty of 209, headed by ROBERT A. MILLIKAN, Chairman of the Executive Council.

**CALIFORNIA LILAC** (*Ceanothus thyrsiflorus*), a handsome woody plant of the buckthorn family growing on canyon sides from Monterey to Oregon, called also blue blossom and blue myrtle. It is usually a shrub 3 to 8 ft. in height, but sometimes becomes a small tree 25 ft. high. It bears smooth, shining leaves and dense showy clusters of blue or rarely white flowers.

**CALIFORNIA MISSIONS**, the term applied to the missions founded between 1697 and 1823 by Spanish monks of the Jesuit, Franciscan and Dominican orders in Upper and Lower California for the purpose of Christianizing the Indians. The first missionary efforts by the Spaniards on the Pacific were those of the Jesuits who between 1697 and 1767 founded 17 missions in Lower California. They were succeeded in their field by the Franciscans and later by the Dominicans but the missions in this section never flourished as did those in Upper California founded by the Franciscans. Father Juniper Serra, who was appointed president of the missions in 1767, founded nine missions before his death in 1784. The missions in Upper California in the order of their establishment are as follows: San Diego de Alcalá, 1769; San Carlos de Rio Carmelo, 1770; San Antonio de Padua, 1771; San Gabriel Arcangel, 1771; San Luis Obispo de Tolosa, 1772; San Francisco d'Assisi, 1776; San Juan Capistrano, 1776; Santa Clara, 1777; San Buena-

ventura, 1782; Santa Barbara, 1786; La Purisima Conception, 1787; Maria Sanctissime (La Soledad), 1791; Santa Cruz, 1791; San Jose, 1796; San Juan Bautista, 1797; San Fernando Rey de Espana, 1797; San Miguel, 1797; San Luis Rey, 1798; Santa Ynez, 1804; San Rafael, 1817; San Francisco Solano, 1823.

These missions were situated about 30 miles, a day's horseback journey, apart and extended for 600 miles along the Pacific coast from San Diego north to Sonoma. The majority were on a connecting highway called El Camino Real or the King's Highway, which is now a well-traveled automobile road marked by mission bell signposts. The padres had a rare instinct for choosing the mission sites which were usually a high mesa or a fertile valley, within sight of the ocean wherever possible, and always near streams whose waters were utilized for irrigation.

The buildings were constructed of adobe or sun-dried brick and occasionally of stone. They were built around a courtyard with the church at one corner. A colonnade of well-proportioned arches, tiled roofs, a bell tower with bells usually brought from Spain and a garden are characteristic. The style of architecture which combined a rugged simplicity with a pleasing harmony of design has been extensively copied, particularly in southern California.

The economic life of California centered around the missions for over 50 years. Under the protection of the padres the Indian converts carried on agriculture, cattle and sheep raising, tanning, weaving and over 50 different arts, professions and occupations. Their principal products were wheat, barley, oats, fruits, beans, tallow, soap, leather, hides, furniture, wool, oil, cotton, hemp, linen, wine, brandy, tobacco, salt, and soda. Great quantities of hides and tallow were shipped to Boston and other cities on the Atlantic seaboard. During the period of greatest prosperity the missions owned over 1,000,000 head of cattle, 100,000 sheep, raised 150,000 bu. of wheat and other grains in like proportion. Their annual revenue was close to \$3,000,000.

During the first 10 years of the missions, 3,500 conversions were made; by 1800 there were 15,000 converts and during their entire history some 90,000 Indians accepted Christianity. This is the greatest record of missionary work in the Western Hemisphere, but as a permanent Christianizing and civilizing agent the missions were not a success. The Indians were so dependent upon the padres that after the disruption of the missions they were wholly incapable of fending for themselves and their numbers diminished appallingly. The first decree of secularization, which meant the downfall of the missions, came in 1823. By 1835 16 out of the 21 had been secularized and by 1840 work was complete. The missions fell into unscrupulous hands, their lands and goods were confiscated and the padres and Indians were forced to flee. From south to north the missions are as follows:

San Diego, the first mission founded by Father Junipero Serra, is 6 mi. east of the city of San Diego. Serra worked a year before he made his first convert.

In 1800, 1,523 converts were living on the premises and the mission owned 28,000 head of livestock and raised over 6,000 bu. of wheat, barley and oats. Ruins of the buildings and of the first irrigation dam in California remain.

San Luis Rey, 85 mi. south of Los Angeles, the proudest monument to the architectural genius and constructive skill of the padres, is now in ruins but its perfectly proportioned dome over the chancel and beautiful Byzantine pulpit are still standing. At the height of its prosperity, it had 2,869 resident Indians and 29,000 head of sheep.

San Juan Capistrano, 58 mi. south of Los Angeles, had 1,046 Indians resident in 1800. Severe damage was done by the earthquake of 1812 at which time the tower and dome fell in on a congregation at prayer, crushing 40 Indians. Services are now held at the mission in a restored chapel.

San Gabriel, Arcangel, in the town of San Gabriel, 8 mi. northeast of Los Angeles, is one of the best preserved of the missions. It was founded at the instigation of the College of San Fernando in Mexico City and made a total of 7,709 baptisms. The mission play depicting early mission life and popularly called the Oberammergau of America has been given here annually since 1912. A modern theater has been erected for the presentation.

San Fernando, about 20 mi. northwest of Los Angeles, is now in an advanced state of decay. In 1825 it was one of the most prosperous of the missions, having cash and assets amounting to between \$150,000 and \$200,000. The first discovery of gold in California is said to have been made by a man connected with this mission.

SAN BUENAVENTURA, 75 mi. northwest of Los Angeles.

SANTA BARBARA, in the city of that name.

SANTA YNEZ, about 25 mi. northwest of Santa Barbara.

La Purisima Conception, about 40 mi. northwest of Santa Barbara, has but one long low adobe building and a few arches of a corridor remaining. In the earthquake of 1812 it suffered severely and was practically ruined by a subsequent flood. It reached its height in 1803 with 1522 Indian residents.

SAN LUIS OBISPO, in the town of that name about 250 mi. southeast of San Francisco.

SAN MIGUEL, 210 mi. southeast of San Francisco.

SAN ANTONIO DE PADUA is 180 mi. southeast of San Francisco and 6 mi. from Jolon.

La Soledad, 145 mi. southeast of San Francisco and 4 mi. from the town of Soledad, has almost vanished.

San Carlos, better known as the Carmel Mission, is 125 mi. southeast of San Francisco and 6 mi. from the town of Monterey. It is a famous landmark in the Monterey Bay country and contains the tomb of Father Serra, by whom the mission was built, as well as the tombs of Fathers Crespi, Lopez, and Lasuen.

San Juan Bautista, 87 mi. south of San Francisco, was famous for its bells which were cast in 1809 in Peru. But one of them remains. The mission was 15

years in construction. It has been partially destroyed but in general is one of the better preserved ruins.

SANTA CRUZ, 80 mi. south of San Francisco on Monterey Bay.

SANTA CLARA, in the town of Santa Clara and 3 mi. from San Jose.

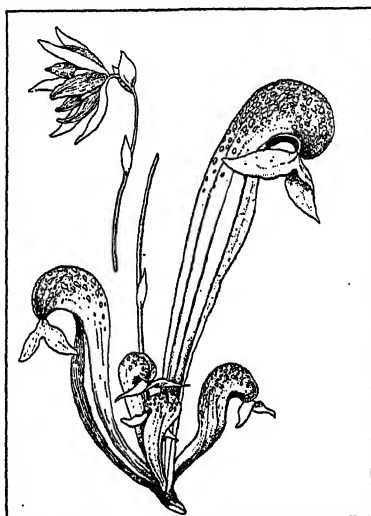
SAN JOSE, 50 mi. south of San Francisco and 14 from San Jose.

SAN FRANCISCO DE ASIS (Dolores), on the bay of San Francisco.

San Rafael, in the town of that name, has only a mission bell guide post to commemorate its site.

San Francisco Solano, a ruin, is 45 mi. north of San Francisco in Sonoma.

**CALIFORNIA PITCHER-PLANT** (*Darlingtonia californica*), an insectivorous plant found in marshy places in the mountains of northern California and southern Oregon. It is a yellowish-green perennial, with a cluster of erect, pitcher-shaped, basal leaves and large, nodding, yellow and purple flowers,



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

CALIFORNIA PITCHER-PLANT

borne singly on long stalks. The hollow leaf stalks are enlarged above into a rounded hood. On one side of the hood is a circular orifice, guarded above with a fish-tail-like appendage. Various insects, attracted by the unusual coloring of the leaves, enter the opening. Guided by downwardly pointing hairs, which prevent their return, they descend to the narrow basal portion of the pitcher. Here they drown in the liquid at the bottom and the products of their decomposition are thought to be absorbed to some extent by the plant for food.

**CALIFORNIA POPPY** (*Eschscholzia californica*), a low perennial with strikingly handsome flowers, closely allied to the true poppy, found abundantly in foothills and valleys west of the Sierra Nevada Mountains. It is in extensive cultivation as an annual and has been widely naturalized in Australia and India. The erect or diffuse stems, about a foot high, bear finely dissected leaves and showy pale yellow to deep

orange-colored flowers, 2 to 3 in. across, which glow in sunshine with a brilliant sheen. This elegant poppy, one of the most common and beautiful of native California plants, is the state flower.

**CALIGULA** or **GAIUS CAESAR** (12-41 A.D.), Roman emperor (37-41 A.D.), the son of Germanicus and great-nephew of TIBERIUS (emperor 14-37 A.D.). He spent his earliest days among his father's troops in Germany, who affectionately called him Caligula or "Little Boots." Escaping the fate which overtook Germanicus and other members of his family he endeared himself to Tiberius. Although Tiberius named his own grandson Tiberius Gemellus as co-heir with Caligula, the senate and people bestowed imperial power on Caligula alone out of respect for his father's memory and because of the extreme youth of Tiberius Gemellus. For a few months Caligula ruled with wisdom and clemency, restoring to the magistrates and people powers of which Tiberius had deprived them and pardoning political offenders. But an illness seems to have unbalanced his mind, and in his last three years he indulged in unparalleled license and extravagance, surrounding himself with the pomp and circumstance of an oriental monarch, thereby offending the free spirit of the Romans. He was assassinated by members of his own praetorian guard.

**CALIPHATE**, the rule of the caliphs, successors of MOHAMMED as supreme rulers of Islam and defenders of the faith. The sect of the Shi'ites maintain that the successors of Mohammed should be lineal descendants from Mohammed's family, and are therefore accustomed to call the caliphs of history *imams* rather than caliphs. The Mohammedans of the Sunni sect are somewhat broader in their interpretations of the term but insist that the caliph must be a member of the prophet Mohammed's tribe, i.e., the caliph must belong to the Koreish. Of the caliphs of history, the four perfect caliphs, as they are called, were the immediate successors of Mohammed and ruled at Medina from the death of Mohammed up to 661. The four perfect caliphs were Abu Bekr, the father-in-law of the prophet Mohammed; Omar, who reigned from 634 to 644; Othman, who ruled until 656; and Ali, who was murdered in 661. The rulers at Damascus then assumed the title of caliph and the 13 so-called Ommiad caliphs ruled up to 750. The rulers at Bagdad were the Abbasid caliphs, of whom there were 37, and who were in control until 1258 when the Tatars conquered the land and the Turkish sultans displaced the caliphs. Members of the Abbasid dynasty fled to Egypt, and their descendants ruled as caliphs until 1517, in which year according to tradition the Turkish sultan Selim I succeeded in capturing the last of these caliphs. Selim I now usurped the title of caliph and the sultans of Turkey of the Ottoman dynasty called themselves caliphs until the outbreak of the World War. When Turkey became a republic after the war, the office of caliph was abolished and the caliphate vested in the National Assembly, 1924. Meanwhile the Ommiad rulers, after they had



lost their power at Damascus in 750, fled to Cordova in Spain and as the Omniad rulers of Mohammedan Spain assumed the title of caliph. This dynasty ruled from 755 to 1031 after which their power was practically lost. The Fatimite rulers of Egypt from 909 to 1171 also called themselves caliphs and claimed descent from Ali and from Fatima the daughter of Mohammed.

**CALISTHENICS**, the science of bodily exercise to promote physical well-being, derives its name from two Greek words meaning strength and beauty. More precisely, calisthenics embraces the less strenuous forms of gymnastics; but in common usage in the United States the word may connote all kinds of systematic body exercise. Calisthenics were an important part of the training in the Greek gymnasium, where youths were schooled to compete in the public games. In modern times, especially dating from the latter half of the 19th century, calisthenics have been recognized as an effective mainstay of health, and in accordance with this view most schools in Europe, England and the United States include systematic physical exercise in the curriculum of their elementary and secondary grades. Previous to that time, the Greek view of calisthenics was ignored, and such exercises as it embraced were considered in the light of recreation.

Calisthenics, in the modern sense, may be divided into two groups, the first comprising light exercises, and the second heavy exercises. The former category includes such exercise as **ACROBATICS**, **BAG-PUNCHING**, exercises with **DUMB-BELLS** and **INDIAN CLUBS**, and **SETTING-UP EXERCISES**, such as simple physical drill of the limbs and bending from the waist. The second and more strenuous group includes exercises on the **HORIZONTAL BARS**, parallel bars and rings, high-kicking, jumping, **ROWING**, pyramid and Roman-ladder exercises, rope climbing, **ROPE WALKING** and **TUMBLING**.

**CALIXTUS**, name of three popes. St. Calixtus I, properly Callistus, 217-222, said to have been a slave of a Christian and of unsavory reputation. His anti-pope was Ippolitus, who was responsible for the bad reputation of his opponent. Calixtus was head of the Roman clergy and later became bishop. The famous Calixtus Catacombs are named after him. Calixtus II, son of Count William of Burgundy, elected Pope at Cluny, 1119, returned to Rome in 1120 and forced Gregory VIII to retire. He concluded the Concordat of Worms with Henry V and died in 1124. Calixtus III, 1455-58, of the Spanish Borgias, preached a crusade and was accused of nepotism. Through him the House of Borgia gained power in the Papal State.

**CALKING** or **CAULKING**, making the edges of steel plates, flanges of angles and points of rivets water or oil tight, by going over them with a steel calking tool operated by compressed air. This term is also applied to wood vessels, where the seams of the planking as the sides and decks must be water tight. In the sides, threads of oakum are laid in the seams and then driven in with a broad flat chisel or calking iron, that is hit by a mallet or beetle. In calking wood

decks, a thread of cotton followed by threads of oakum are driven in below the surface of the planking, and into the seam is poured marine glue or pitch.

**CALKINS, MARY WHITON** (1863-1930), American philosopher, was born at Hartford, Conn., March 30, 1863. In 1885 she was graduated from Smith College and later studied at Clark College and Harvard University. In 1891 she joined the faculty of Wellesley College, becoming research professor of philosophy and psychology. She was best known for her *Persistent Problems of Philosophy*, 1907, dealing with the history of modern philosophy from an idealistic viewpoint. The goal of thought is toward absolute idealism. Her other works are two textbooks in psychology and *The Good Man and the Good*, 1918. She died at Newton, Mass., Feb. 26, 1930.

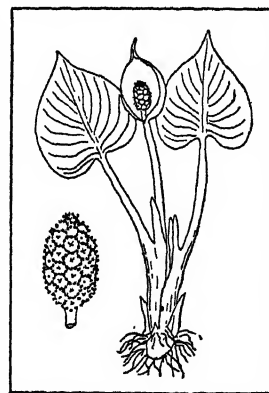
**CALL.** See **PUT AND CALL**.

**CALLA** (*Zantedeschia æthiopica*), an African perennial herb of the arum family, grown for its ornamental, fragrant, white, flower-like spathe. It is sometimes called calla lily and lily-of-the-Nile, but even casual comparison with true lilies will show such names to be misapplied. In warm climates the calla is often a permanent resident of gardens, but in cold ones it must be dug up and stored in frost-proof quarters upon the approach of cold weather. It is a favorite house plant though it often fails to bloom in modernly warmed houses. After flowering the plants may be dried (rested) or kept growing continuously. When grown as house plants summer rested tubers generally bloom better than those kept active from year to year. California supplies the American market with dry tubers. Florists plant these in greenhouse benches filled with rich loam and supply them with abundant water.

M. G. K.

**CALLA, WILD** (*Calla palustris*), a perennial aquatic herb of the arum family called also water arum. It grows in bogs widely throughout northern Europe and Asia and also in northeastern North America. This aquatic is a strikingly beautiful plant with heart-shaped, glossy green root leaves borne on stalks 4 to 8 in. long. The pure white flowering spathe resembles that of the calla lily of the gardeners but is much smaller and flatter. At the base of the spathe is a short spadix bearing a cluster of small flowers from which develops a showy head of bright red berries. These berries mature in August.

**CALLAO**, a seaport town of PERU, the port of LIMA, from which it is 8 mi. distant. Callao, except for Chimbote, has the best harbor below Panama. It ranks in traffic as the fourth American port on the



P. A. RYDBERG. "FLORA OF PRAIRIES AND PLAINS"

WILD CALLA

entire Pacific, following Seattle, San Francisco and Valparaiso. Callao has been distinguished as the only port south of Panama with docks, to be completed in 1932, which are accessible to large vessels. However, as until recently, the accommodations were inadequate, passing coastal steamers usually anchored half a mile away, employing lighters for cargo. The new port development work, lasting from 1927 to 1932, represents one of the many improvement programs at South American ports to aid foreign shipping. A floating dry dock receives ships of 8,000 tons. Est. pop., 1927, 75,000.

**CALENDAR, HUGH LONGBOURNE** (1863- ), English physicist, was born at Hatherop, Gloucestershire, in 1863. After study at Marlborough and Cambridge he was appointed professor of physics at McGill University, Montreal, where he taught during 1893-98. In the period 1898-1902 he was on the faculty of University College, London. Callendar was concerned chiefly with problems of thermodynamics. He designed an electric resistance thermometer and evolved a method of calculating specific heats. His investigation and tables on the thermodynamics of steam were of wide industrial importance; other researches were made by him in problems affecting gasoline engines. In 1906 Callendar was awarded the Rumford Medal and in 1924 received the Duddell Memorial Medal of the Physical Society.

**CALLES, PLUTARCO ELÍAS** (1877- ), Mexican President, was born in Guaymas, Sonora, Sept. 25, 1877. While teaching school he became concerned with the economic and political conditions of Mexico, and supported Carranza's campaign against the Huerta Government. He was minister of commerce, labor and industry in Carranza's cabinet, and secretary of the interior under Obregón in 1920-24 when he was elected President. In this office he continued Obregón's progressive and democratic policies, became involved in a bitter quarrel with the Church, and effected a satisfactory settlement of the disputes with foreign countries over titles to petroleum lands. His term expired in 1928.

**CALLICRATES** (5th cent. B.C.), Greek architect, lived in Athens about the middle of the 5th century, B.C., although the precise place and date of his birth and death are unknown. With his fellow architect Ictinus, he built the Parthenon, the construction of which was begun in 447 B.C. and is believed to have been completed by 438 B.C. Phidias, the sculptor, who carved the famous frieze, was in general charge of the work, which is universally regarded as the most perfect Doric building in existence.

**CALLIMACHUS** (c. 310-c. 240 B.C.), Greek grammarian, poet and critic, was born at Cyrene, about 310 B.C. He was a resident of Alexandria for many years and founded a school there, which Aristophanus of Byzantium and Apollonius of Rhodes both attended. While librarian of the Alexandrian Library, he catalogued its books, making criticisms and notes on the authors. Of Callimachus's 800 works, only 6

hymns and 64 epigrams remain entire. His elegy, *Berenice's Lock*, has been preserved in translation by Catullus. His elegies influenced Ovid and Catullus.

**CALLINUS** (c. 630-c. 560 B.C.), first Greek political elegiac poet, was born at Ephesus, about 630 B.C. It is thought that he lived during the struggle for Asia Minor by the Cimmerii and the Alyattes. His poetry is patriotic, but only fragments remain. Callinus died about 560 B.C.

**CALLIOPE**, in Greek mythology, one of the nine Muses.

**CALLIOPE**, a movable organ, equipped with whistles operated by steam and furnished with a conventional keyboard. It is named after the Greek muse Calliope, the mother of Orpheus. The music produced is crude and strident, but the instrument is popular at circuses, street-fairs, and the like.

**CALLISTO**, in Greek mythology, an Arcadian nymph, the daughter of Lycaon. Arcas was her son by Zeus. She was transformed into a bear and would have been shot by her own son had not Zeus carried her to the skies, where she remains as the constellation of the Bear.

**CALL LOAN**, a loan made for an indefinite period, terminable at any time by the lender. Such a loan may be made on any form of security, but in the United States it is usually secured by good Stock Exchange collateral. The majority of these loans are made to brokers to enable them to pay for stock purchased by customers on Margin. The broker obtains call funds ordinarily from one of the New York City banks, lending for its own account or for the account of out-of-town banks, foreign banks, corporations or investment trusts.

Objections have been raised that although realizable in normal times, they cannot be called in a crisis, when all lenders are trying to recover their funds at once, without creating a PANIC.

The close link between bank funds and Stock Exchange loans has been one of the outstanding problems of American bank history, and many attempts have been made to sever this relationship. While the organization of the FEDERAL RESERVE banks succeeded in removing the legal reserve funds of banks from the call market, they still have large amounts loaned there, depending upon the amount of speculative activity in stocks, relative rates of interest on different types of loans, and the seasonal demands for funds. The call loans made by the New York City banks for their own account, for the account of out-of-town banks, and for others, is reported weekly by the Federal Reserve bank; while the New York Stock Exchange reports monthly the amount of such funds borrowed by its members. See also DAY LOAN; FEDERAL RESERVE.  
B. H. B.

**CALMETTE, ALBERT** (1863- ), French bacteriologist, and investigator in the field of immunology and medicine, was born at Nice, July 12, 1863. He is best known for his ophthalmology-reaction, or the diagnosis of tuberculosis by application of tuberculin to the eye, but has more recently come into promi-

nence because of his development of the technique of vaccinating children against tuberculosis with living attenuated organisms, the form known as bacillus Calmette-Guerin.

**CALOMEL**, common name for mercurous chloride, mild, ( $\text{HgCl}_2$ ), a white powder practically insoluble in water or alcohol. Undergoes change when exposed to action of light. Mild mercurous chloride does not irritate the mouth or stomach, but causes bowel movements by slow action, though it is fairly powerful as a cathartic. Overdosage may produce symptoms of mercury poisoning, such as salivation. Mild mercurous chloride is also employed to increase the flow of urine in dropsy, as a dusting powder and ointment for ulcers and for treatment of syphilis. It is also used as a 33⅓% ointment in venereal prophylaxis. *See also* CATHARTICS.

**CALORESCENCE**. When radiant energy falls on a body, part of it is reflected, part is transmitted and part is absorbed. The absorbed energy is usually transformed into heat and then radiated again as energy of different wave-lengths. Tyndall found that a solution of IODINE in carbon bisulphide, which is opaque to light, transmits most of the accompanying invisible infra-red, or heat, rays. By placing a spherical glass flask filled with this solution before an arc light, he focused this invisible radiation on a piece of blackened platinum. The energy which the platinum absorbed raised its temperature to incandescence, so that it gave off light. Tyndall named this phenomenon *calorescence*.

This emission of light is strictly a thermal effect, and calorescence is not exactly the converse of luminescence. The second law of THERMODYNAMICS shows that a body, unless undergoing chemical change, cannot be heated by the radiation that it absorbs to a temperature higher than that of the source of that radiation. *See also* ABSORPTION OF LIGHT.

**CALORIC**, a term applied to a hypothetical, invisible, weightless fluid by the presence or absence of which the early scientists explained the phenomena of heat. When it was established that heat is a form of ENERGY, the caloric theory was abandoned completely, but relics of it still remain in such expressions as "flow of heat."

**CALORIE**, the amount of heat required to raise the temperature of one gram of water one degree centigrade. This is the small, or gram, calorie. The large, or kilogram, calorie is the amount of heat required to raise the temperature of one kilogram of water one degree centigrade. It equals 1,000 small calories. In dietetics, the values of foods are usually stated in large calories. For very accurate scientific work, the calorie must be defined more exactly, since the specific heat of water is not the same at all temperatures. The 15° calorie is the amount of heat necessary to raise the temperature of one gram of water from 14.5° to 15.5°C. *See also* BRITISH THERMAL UNIT.

**CALORIMETRY**, the measurement of the quantity of heat. It must be distinguished from THER-

MOMETRY, the measurement of temperature. Two bodies may be at the same temperature and yet possess very different quantities of heat, e.g., a cup of water and a tub of water. Or a large body may possess much more heat than a smaller body which has a higher temperature, e.g., a tub of water at room temperature and a teaspoonful of hot water. Since heat is a form of energy, it may be measured in units in which energy is measured. However, it is usually more convenient to employ one of the special heat units, such as the CALORIE or the BRITISH THERMAL UNIT.

The various processes of calorimetry, such as the measurement of specific heat, heat of combustion (*see* COMBUSTION, HEAT OF) and heat of reaction, usually involve some application of the principle of the *method of mixtures*. This principle, which is really a special case of the law of the conservation of ENERGY, may be stated as follows: When a hot body gives up heat to a cold body, the amount of heat lost by the hot body is equal to the amount of heat gained by the cold body. A second principle which is frequently involved is that the heat given up by a substance in cooling from one temperature to another is equal to the heat necessary to raise its temperature through the same interval. This, too, follows directly from the law of the conservation of energy.

Since the calorie and the B.t.u. are defined as the heat necessary to raise the temperature of a given quantity of water 1°, many calorimetric processes use water as the cold body. Thus, suppose that the SPECIFIC HEAT of iron is to be measured. A known mass of iron,  $m_1$ , is heated to a known temperature,  $t_1$ , and a known mass of water,  $m_2$ , at a lower temperature,  $t_2$ , is prepared. The hot iron is then placed in the cold water and the temperature,  $t_3$ , to which the water and iron come is noted. The heat lost by the iron in cooling from  $t_1$  to  $t_3$  is  $m_1(t_1 - t_3)x$ , where  $x$  is the specific heat of the iron. The heat necessary to raise the temperature of  $m_2$  grams of water from  $t_2$  to  $t_3$  is  $m_2(t_3 - t_2)$ . By the principle that heat lost equals heat gained we write  $m_1(t_1 - t_3)x = m_2(t_3 - t_2)$  and solve this equation for  $x$ .

This example illustrates the principle, but the actual process is not quite as simple as the description indicates. Actually, it is necessary to take many precautions to insure that all of the heat lost by the hot iron is really given to the water. A hot body radiates heat to its surroundings. Consequently, unless great care is taken, the iron will lose heat to the air or to the objects with which it is handled during the transfer from the heater to the water. Also, the water must be contained in a vessel or cup, the CALORIMETER, and this, as well as the water, absorbs heat. Consequently, it is necessary to insert a term in the equation given above to account for the heat absorbed by the calorimeter. If  $m_3$  is the mass of the calorimeter and  $s$  its specific heat,  $m_3s$  represents the heat necessary to raise the temperature of the calorimeter 1°. This is called the *water equivalent* of the calorimeter, since it represents the mass of water which would

absorb the same amount of heat as the calorimeter. The corrected equation for this specific heat determination is  $m_1 (t_1 - t_3) x = (m_2 + m_3 \cdot s) (t_3 - t_2)$ .

Even this equation will not lead to correct results unless a number of precautions are taken. If the calorimeter and its contents are not at the same temperature as the surrounding air, they will lose heat to, or gain heat from, the air by radiation (*see* RADIATION OF HEAT). Hence, in accurate work, a radiation correction is necessary. To avoid this correction, a number of special calorimeters and processes have been devised, such as Bunsen's ice calorimeter.

Other calorimetric operations, such as finding the heat evolved or absorbed in a chemical reaction or the latent heat of VAPORIZATION of a liquid, involve the same fundamental principles as the simple measurement just described.

For processes in which heat is evolved at a constant rate, some form of continuous-flow calorimeter is usually used. In these instruments, water flows through the apparatus at a uniform rate and absorbs the heat as it is evolved. When a steady state is reached, the difference between the temperatures of the entering and escaping water multiplied by the mass of the water which flows through the calorimeter in any given time gives the amount of heat evolved in that time. The Junker calorimeter, used for finding the heat of combustion of illuminating gas, is of this type. *See also* GAS CALORIMETER; BOMB CALORIMETER. W. W. S.

**CALORIZING.** *See* METAL COATINGS.

**CALTANISSETTA**, capital of the province of the same name in the mountainous region of southern Sicily and the most important city in the interior of the island. It lies near the fertile Salso valley, is the seat of a bishop and has mining and other schools and a theological seminary. The city is regularly laid out and of modern appearance. Among the interesting buildings are the cathedral, a fine baroque palace of justice, a small museum of antiquities, and Saracen-Roman ruins. To the east is the extensive cloister Badja di Santo Spirito, 1154, and the volcano Terra Pilata. Large quantities of sulphur are exported. Pop. 1931, 51,609.

**CALUMET**, the ceremonial pipe used by certain Indians of North America consisting of a shaft made of reed or wood and a bowl of white stone or of pipe-stone. It was also known as the peace-pipe or war-pipe. Its most important uses were in connection with war and with ratification of peace treaties but it also figured in social and political occasions of many kinds and in connection with commerce and trade. The shaft was ordinarily about 2½ ft. long. Its decorations, which varied according to its use, included eagles' feathers and wings as well as those of other birds, porcupine quills and woven locks of hair. In times of war part or all of the feathers might be dyed red. Pipes with shafts symbolically inscribed were presented to distinguished persons on important occasions as a token of esteem and good will. Elaborate dances and ceremonials accompanied the smoking of the

calumet, which served as an altar for burning sacrificial tobacco to the gods and which was one of the most profoundly sacred objects known to the Indians of North America. Its use centered principally in the Mississippi Valley.

**CALUMET CITY**, a city of Cook Co., Ill., on the Calumet River, 11 mi. south of Chicago. It is served by the Baltimore and Ohio, Chicago Terminal, Michigan Central, Indiana Harbor Belt and Pennsylvania railroads. The retail trade in 1929 amounted to \$1,896,451. The name of the city was changed from West Hammond in 1924. Owing to the growth of industries, including meat-packing, glue-making and steel-founding, there is a steadily increasing population. Pop. 1920, 7,492; 1930, 12,298.

**CALVARY** (Latin *calvaria*, skull), mound of skulls, at places of execution, especially in reference to Christ's crucifixion; therefore, in Catholic countries hills, visited by pilgrims, upon which are crucifixes, statues and pictures or reliefs (the 14 Stations of the Cross) representing successive scenes of the Passion of Christ. The Calvary of St. Valerian near Paris is an example.

**CALVÉ, EMMA** (stage name of Emma de Roquer) (1864- ), French soprano, was born at Decazeville, Aveyron Department, in 1864. She made her début at Brussels in 1882, singing in Massenet's *Herodiade*, soon afterward resuming studies with MATHILDE MARCHESI and Rosine Laborde. In 1884 she appeared at the Opéra-Comique, Paris, and in 1892 made her London début at Covent Garden, singing in *Cavalleria Rusticana*. During 1893-1904 Calvé was a leading member of the Metropolitan Opera, New York, where her celebrated rôles were in *Carmen*, *Sapho*, and *Le Pêcheur de Perles*. She retired from opera in 1910, devoting herself to concert appearances. In 1927 she made a lecture tour of the United States, and on Aug. 15, 1931, the 50th anniversary of her first appearance, she sang in concert at Paris.

**CALVIN, JOHN** (1509-64), Protestant reformer and theologian, was born Jean Chauvin or Caulvin, at Noyon, Picardy, France, July 10, 1509. He was educated at the Collège de la Marche and the Collège Montaigu in Paris, also studying at Orleans and at Bourges in 1528-29. In 1527 the canons of Noyon awarded him the curacy of St. Martin de Marteville, which he exchanged two years later for the parish of Pont l'Évêque. About 1532 he accepted the new Protestant position in religion. Soon after his conversion he was forced to flee Paris when the parlement demanded an explanation of his claim of divine communication. At Basle in 1536 Calvin published his best known work, *Institutes of Religion*, in Latin, so that it might be read by scholars of the Continent; this is a celebrated polemical exposition of the Protestant doctrine. In 1537 he settled at Geneva whence he was exiled in 1538, returning in 1541. In 1553 occurred the episode with the heretic Michael Servetus, for whose death Calvin has often been censured. Servetus, charged with blasphemy, was attempting to escape to Naples when he was apprehended through

the efforts of Calvin and burned at the stake after a trial which endured for 10 weeks. In 1559 the Protestant theologian established the Academy of Geneva in which he prepared his followers to teach his principles throughout Europe. His dispute with the Lutherans concerning the Lord's Supper ended in the formation of a separatist Protestant group, known as the Reformed party. Thereafter in Geneva Calvin was for the most part unopposed, and he continued with unflagging energy his vigorous defense and dissemination of his view of Protestantism. To that cause his two great contributions were the codification of its doctrine, which had not been stated with precision in the turmoil of the REFORMATION, and his formulation of church discipline, an evident necessity if formal Protestantism was to endure. His honesty and sincerity, reflected by a personal austerity which he imparted even to his followers in posterity, have rarely been questioned by religious historians, although some of his biographers have laid critical emphasis on his severity and, as in the instance of Servetus, his cruelty. His teaching, followed in the next century by the Presbyterians in the Westminster Conference, stressed the sovereignty of God and pronounced the predestination of the elect; Calvinism, as the body of his theological beliefs was called, profoundly affected Scotland and Puritan England and, accordingly, the Puritan thought in the New England colonies. Calvin's influence at Geneva made that city for many tumultuous years a refuge for his adherents, who referred to it as "the city of Calvin." He died at Geneva, May 27, 1564.

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**CALVINISTS**, the term applied to those who follow the system of JOHN CALVIN. In theology this means the recognition of the absolute sovereignty of God, whose will is the only moral law for man, and whose decree alone determines man's fate. Human freedom is not denied, but nothing that man can do affects his destiny. God has elected some to salvation and some to reprobation. This system has not paralyzed human effort because Calvinists have thought of themselves as the elect. In ethics the chief end of man is to glorify God, not by a renunciation of the world and its goods, but by labor and gain and a renunciation only of diverting frivolities. Thus was a divine sanction given to the virtues of a commercial society. In church polity Presbyterianism was the normal form, though Calvinist theology was not infrequently combined with Episcopacy. In political theory Calvinists went far beyond Calvin's restrained utterances as to the right of revolution and came to allow even tyrannicide. Calvinism has been associated with the struggle for parliamentary Government. In general Calvinists have practiced religious persecution for the glory of God, though ROGER WILLIAMS is a notable example of the combination of a Calvinist theology and a theory of religious liberty.

In the Netherlands the Calvinists reached the peak of their influence at the Synod of Dort in 1618. The

assembly was called because of the controversy raised by the attack of Arminius on the Calvinist doctrine of predestination. The theological quarrel was complicated with political issues since the Calvinists were Nationalists, devoted to the house of Nassau and committed to war with Spain, whereas the Arminians were for peace and a decentralized Government. The Synod outlawed the Remonstrant Arminians, who only gradually obtained toleration.

The history of the Church of Scotland is the history of Calvinism. In England the Elizabethan settlement was Calvinist in theology, although episcopal in polity. The zenith of Calvinist influence came during the Civil Wars with the meeting of the Westminster Assembly in 1642. The Restoration introduced a violent reaction to Puritanism and ushered in the Deism of the 18th century. Calvinism experienced a revival in some branches of Methodism, as the Calvinistic Methodist Church of Wales and Lady Huntington Connexion in England, established under the influence of Whitefield, who was Calvinist. JOHN WESLEY was Arminian.

The English Independents were prevailingly Calvinist in theology. Through them as well as through the Puritans, Calvinism took hold in New England, where the Westminster standards were adopted in 1648. After the Restoration in England Arminian views invaded the colonies until JONATHAN EDWARDS, in his sermon on the Freedom of the Will, 1754, revived the Calvinist doctrines of election, though his followers adopted an Arminian doctrine of the atonement. Calvinist theology in New England did not break down until our own generation. The primary characteristic of the Calvinists has been a terrific conviction which humbled an empire, beheaded a king and tamed a wilderness.

See W. Walker, *John Calvin, the Organizer of Reformed Protestantism*, 1906.

**CALVO, CARLOS** (1824-1906), Argentine diplomat and author, was born in Buenos Aires, Feb. 26, 1824. He was ambassador in Berlin, London and Paris and is known as a co-founder of the "Institut De Droit International," 1884. The publication in 1863 of his principal work, *Derecho Internacional Teórico y Práctico*, gave him a foremost place as an authority on international law. The *Calvo Doctrine*, first advanced in 1902, gave his name historical importance. His *Recueil historique complet des traités . . . l'Amérique latine . . .*, 15 vols. 1862-67, is also important. Calvo died at Paris, May 4, 1906.

**CALVO DOCTRINE**, the proposed rule that armed and diplomatic intervention cannot be used legitimately for the purpose of collecting private claims of a pecuniary nature. It refers especially to claims arising from insurrection, civil war or mob violence, and such as are based upon contract. To admit the validity of this method of enforcement would, according to its author, CARLOS CALVO, establish a privilege favorable to great and powerful states and injurious to weaker states and would establish an objectionable inequality between citizens and aliens.



**CALYCANTHUS**, a small genus of aromatic shrubs of the calycanthus family often planted for ornament and for their highly fragrant flowers. There are four species of which three are natives of the southeastern United States and one of California, commonly called sweet-scented shrub, strawberry shrub and Carolina allspice. They are low, branching shrubs, 2 to 9 ft. high, with opposite, entire leaves and large, usually dark red or purplish flowers borne singly on short leafy branches. *See also* ALLSPICE, CAROLINA.

**CALYDON**. 1. The name of a prince of Calydon, also called Meleager, famed in mythology for slaying the Calydonian Boar. 2. An ancient city of Aetolia, Greece. 3. A legendary forest in the north of England, frequently mentioned in the ARTHURIAN LEGENDS.

**CALYDONIAN HUNT**, in Greek and Roman mythology, the hunt for the boar sent by ARTEMIS to destroy the fields of Calydon in Aetolia. King Oeneus had neglected to make sacrifice to Artemis, who took this means of punishment. The King's son, Meleager, led the heroes who slew the boar.

**CALYPSO**, in Greek mythology, the daughter of ATLAS. She lived on the island of Ogygia where ODYSSEUS was wrecked. She promised him immortality if he would marry her. He stayed with her seven years, but then desired to return to Ithaca. At the bidding of ZEUS, through HERMES, Calypso let him go, but died of a broken heart.

**CAM**, a river rising in Essex, England. It is called the Granter until it merges with the Rhee, several miles above Cambridge. The town derives its name from the river, and the famous Cambridge University boat races are held on it. Following a 40-mi. northeasterly course, the Cam flows into the Ouse above Ely.

**CAMAGÜEY**, or Puerto Príncipe, a city of Cuba, situated about 160 mi. northwest of Santiago in Camagüey Province, at an altitude of 550 ft. It is the largest inland city of the island, a port of call for the Pan-American Airways, Inc., and the most important railroad center east of Havana. At the time of the American occupation, a drainage system was installed, and a pure water supply secured from artesian wells. Although the streets are narrow and crooked it has street cars, long distance telephone connection and other modern improvements. It is in the center of a productive sugar, tobacco and cattle district, and its chief industry is trading in cattle and sugar. It was founded in 1516 by Diego de Velasquez. Est. pop. 1930, 48,773.

**CAMALDOLESE ORDER**, the Congregation of Monks and Hermits of Camaldoli, the first monastic institute in the West to combine the eremitical and cenobitical forms of religious life. It was founded about 1012 by St. Romuald at Camaldoli (*Campus Maldolus*), Tuscany. The founder's unwritten legislations, based on the ascetic life of Eastern hermits, were later modified by the Constitutions of Blessed Rudolph who made a separate branch of the cenobites

modeled on the Benedictine Rule. After six centuries of steady growth guided by the Holy Hermitage (Camaldoli), the order gradually split up into the five congregations of the Holy Hermitage, San Michele di Murano, Monte-Corona Turin, and Notre-Dame de Consolation. To-day there are three congregations; Cenobites, Hermits of Etruria and Hermits of Monte Corona, having an approximate total membership of 250 and about 20 establishments in Italy, Poland and Brazil. This does not include convents of nuns associated with the order from an early date (1086). Guido d'Arezzo and Gratian were both Camaldolese monks.

**CAMARASA DAM**, located on the Rio Noguera Pallaresa, 80 miles from Barcelona, Spain. This dam, forming part of a comprehensive water power development, is a gravity type structure, slightly curved in plan, 333 feet high above lowest foundation level and about 275 feet above the bed of the river. The thickness at the base is 270 feet, the top length 460 feet, and it contains 285,000 cubic yards of cyclopean concrete. It is a non-overflow dam, the spillway being a separate structure at one end.

**CAMBACÈRES, JEAN JACQUES REGIS DE, DUKE OF PARMA** (1753-1824), French statesman, was born at Montpellier in 1753. Sent to the Convention in 1792, he devoted himself entirely to legislative work. Cambacères was instrumental in the organization of the Committee of Public Safety, and as the representative of a commission of the Convention, he proposed the scheme from which finally came the CODE NAPOLEON. (*See FRANCE: History.*) Sièyes obtained for him in 1799 the office of Minister of Justice. He became Second Consul, then arch-chancellor and Prince of the Empire, and in 1808 received the title of Duke of Parma. In 1813 Cambacères became President of the Regency, but after the second downfall of Napoleon he was banished. Returning after the amnesty, he retired from public life. He died on Mar. 5, 1824.

**CAMBER**, in bridge design, the vertical distance the center of a bridge span is raised above the horizontal line through its ends. All well-designed bridges are so curved as to allow for the deflection calculated for the bridge loaded with its own and any extraneous weight. When fully loaded, it should come to a horizontal line. The strength of the structure is not affected by this original distortion. In marine engineering, camber or crown is the curve given to deck beams of a vessel so that water will run off the deck. All beams of weather decks have a camber, although often those on lower decks are straight. The amount of camber varies, but is usually about  $\frac{1}{4}$  of an inch to the foot in the ship's beam.

**CAMBODIA**, a protectorate within French Indo-China. It lies south of Siam and Laos, east of Siam, north of Cochinchina, and northeast of the Gulf of Siam. Area 67,550 sq. mi.; pop. 1926, 2,535,000. Over 2,100,000 are Cambodians, but there are also 95,000 Chinese, 152,000 Annamites, 61,600 Chinese-Cambodians, 61,300 Malays and 20,100 Loatians.

The region is a saucer-shaped basin and in this respect compares with the basin of eastern Siam, but the soil is more fertile and the climate more favorable. Less than 2,000,000 acres of the surface are under cultivation, but this is due more to shortage of labor than infertility. The chief product is rice. Cotton growing for export is extending. Other crops are pepper, tobacco, kapok, coffee, indigo, and rubber. Cattle breeding is a flourishing native industry; but an even more important industry is fishing. In the wet season, April to October, the overflow of the Mekong fills Tonle Sap lake; in the dry season the lake slowly empties and leaves innumerable pools in which there are enormous numbers of fish suitable for salting and smoking. Much of the fish is exported to China. Valuable forests are said to cover 10,000,000 acres in Cambodia. The country is rich in ancient monuments, among the chief of which is the great lost city of Angkor Thom. Cambodia's reigning monarch since 1904 has been King Sisowath, who is advised by a French Resident stationed in the capital, PNOM-PENH.

**CAMBRAI**, an industrial city in northeastern France, in the department of Nord, about 35 mi. southeast of Lille. It is famous for its manufacture of the fine linen fabric invented here in the 13th century, probably by Baptiste of Cambrai, and called by the French "batiste" and by the English "cambric." During the World War Cambrai was much fought over and badly damaged; for almost the entire duration of the war it was occupied by the Germans. Near here, on Nov. 20, 1917, tanks were first used extensively in battle. Pop. 1931, 25,407. *See also* WORLD WAR.

**CAMBRAI, BATTLE OF**, a British drive in the WORLD WAR, launched Nov. 20 and ending Dec. 5, 1917, significant for a surprise attack by tanks substituted for the traditional bombardment. The attack was an attempt to circumvent the handicaps of the established method of bombarding the enemy front before the infantry advance, a method in which any element of surprise was impossible, and which made the ground impassable for attacking troops. After careful preparation, 476 tanks moved forward on a six-mile front, extending from a point east of Lagnicourt southeasterly to Gonnelleu, thus aiming at Cambrai behind the powerful Hindenburg Line. With infantry in front, to pick off field gunners, and reserves behind to "mop up" the German trenches, the tanks on the first day advanced five miles, and made possible the capture of nine villages and 8,000 prisoners. But while the attack had pierced the German main line of defenses, the British lack of reserves lost the Allies a magnificent opportunity to exploit the advance. The British were within three-quarters of a mile of Cambrai when the Germans counter-attacked on Nov. 22, and launched a fierce offensive on Nov. 30. By Dec. 5 the British had been pushed back to approximately the original line.

**CAMBRIAN PERIOD**, the opening period in the PALEOZOIC ERA of geological history. It is marked

by the first abundantly fossiliferous strata, and characterized by the dominance of trilobites in the life of that time.

**CAMBRIDGE**, a municipal borough and university town of Cambridgeshire, England, on the river Cam, 56 mi. northeast of London. It was a small Roman settlement, later important as being at the head of river navigation and university life. Cambridge to-day is a place of spacious gardens and picturesque buildings, with a pleasant commingling of countryside. The river, earlier known as the Granta, edged by the garden-like meadows along which are willows and the mellow backs of the colleges, is one of the most beautiful in England. The meadow walk leads to Grantchester, the quaint village of Rupert Brooke's poem. In the town ancient stately colleges blend with Georgian houses, the façades of which often hide earlier structures, and there are unspoiled old streets, as those beyond St. John's, and wedged between buildings, narrow courts that once were inn yards. Beyond the blend of grandeur and tumbling roofs rises the mound of the Norman castle, the stones of which were built into many of the colleges. Sections of Cambridge are fast becoming modernized, but a keen struggle is being made to preserve its ancient, mellow quality. Pop. 1921, 59,264; 1931, 66,803.

**CAMBRIDGE**, a port town in eastern Maryland, the county seat of Dorchester Co., on the Choptank River, near Chesapeake Bay, 40 mi. southeast of Annapolis. Steamships and the Pennsylvania Railroad afford transportation. The town is an agricultural center and ships oysters, oyster-shell and fish. The chief manufactures are lumber, canned goods, wire, shell-lime and fertilizers. There are commercial fisheries here. Pop. 1920, 7,467; 1930, 8,544.

**CAMBRIDGE**, a city in eastern Massachusetts, the county seat of Middlesex Co., situated on the Charles River, as a suburb of Boston. It is served by bus and truck lines, the Boston and Maine and the Boston and Albany railroads. Cambridge is the seat of HARVARD UNIVERSITY, Radcliffe College, the MASSACHUSETTS INSTITUTE OF TECHNOLOGY and three theological seminaries. The chief local manufactures are books, candy and electrical machinery. The total factory output in 1929 was worth \$174,621,196. The wholesale trade, 1929, amounted to \$22,095,638, and the retail business to \$54,563,570. Cambridge has been the home of many famous Americans, including Edward Everett, Henry Wadsworth Longfellow, James Russell Lowell, Oliver Wendell Holmes and Louis Agassiz. Gov. Winthrop chose this site for the capital of Massachusetts in 1630. Cambridge became a city in 1846. Pop. 1920, 109,694; 1930, 113,643.

**CAMBRIDGE**, a city of middle eastern Ohio and county seat of Guernsey Co., about 25 mi. northeast of Zanesville. The Pennsylvania, which maintains division shops here, and the Baltimore and Ohio railroads serve the city; it is also intersected by Federal and state highways. Cambridge is located in a coal-mining region, where pottery clay also is found. Miscellaneous manufactures, valued at approximately

\$10,000,000 in 1929, include products of iron, steel, tin, wood, and glass, china, earthenware, gloves, and chairs. During 1929 the retail trade amounted to \$8,317,445. Muskingum College is at New Concord, 8 mi. west of Cambridge. The county was named for the Isle of Guernsey, the native land of the early settlers in 1798. The Cambridge town site was plotted in 1806, the city chartered in 1893. Pop. 1920, 13,104; 1930, 16,129.

**CAMBRIDGE, UNIVERSITY OF**, the younger of the two ancient English universities, at Cambridge, Cambridgeshire, England. It had its origin as a center of learning in the monastic communities which settled in Cambridge, under the supervision of the bishops of Ely, in the 11th and 12th centuries. Like **OXFORD UNIVERSITY**, Cambridge is made up of various colleges. Each college is a small individual corporation within the larger corporation of the university, and each has its students, fellows and tutors, and its own head, called the master, the provost or the president. The oldest of the colleges is Peterhouse, founded in 1284 by Hugh de Balshau, Bishop of Ely. The second to be founded was Clare College, in 1336; it was originally founded as University Hall in 1326. The others, in the order of their founding, are: Pembroke; Gonville Hall, enlarged in 1558 into Gonville and Caius College; Trinity Hall; Corpus Christi; King's; Queen's; St. Catherine's; Jesus; Christ's; St. John's; Magdalene; Trinity; Emmanuel; Sidney Sussex; Downing; and Selwyn. There are two women's colleges recognized by the university, **GIRTON COLLEGE** and **NEWNHAM COLLEGE**. The number of undergraduates at Cambridge is about 4,900; of Bachelors of Arts, 400; of advanced students, 200; and of Masters of Arts, 1,100; making a total of approximately 6,600 members. The chancellor of the university in 1931 was the Rt. Hon. **STANLEY BALDWIN**. The new statutes of 1926 provided the university with a substantial annual government grant.

Architecturally, Cambridge is best represented by King's College Chapel, a perpendicular Gothic edifice, founded by Henry VI in 1440, and completed in 1515, with fine stained glass and magnificent fan vaulting. The university church is Great St. Mary's Church, built in perpendicular Gothic. The Fitzwilliam Museum, founded in 1816, is the most notable at Cambridge. Others of note are the museums of Ethnology and Anthropology and the Museum of Classical Archaeology. The university library contains over 1,000,000 volumes.

**CAMBYSSES**, the name of several kings of ancient Persia. The most famous of them ruled from 528-521 B.C. Wishing to add to the territories bequeathed him by his father **CYRUS THE GREAT** he undertook the conquest of Egypt. He overwhelmed the Egyptian army at Pelusium in 525 B.C., and captured Memphis. His efforts to extend his dominion into Ethiopia were unsuccessful, and a projected expedition against Carthage he reluctantly abandoned. Discouraged by a formidable rebellion from his authority in his Asiatic dominions, he committed suicide.

**CAMDEN**, a city and the county seat of Ouachita Co. in southern Arkansas, situated on the Ouachita River, 103 mi. by highway south of Little Rock. Bus and truck lines, steamboat lines and three railroads serve the city; 8 state highways connect it with other parts of the state. Camden is an agricultural market for a region producing cotton, truck garden produce, fruit and live stock. It is also a manufacturing center; oil refining, cotton ginning, wood-working, machine shop work, paper and furniture making forming the chief industries. Pop. 1920, 3,238; 1930, 7,273.

**CAMDEN**, a city, port of entry, and the county seat of Camden Co., N.J., situated on the Delaware River opposite Philadelphia, with which city ferries, railroad tubes and a large suspension bridge afford connection. It is served by the Pennsylvania and Reading railroads, trolleys, and steamship, bus and air lines. Its many and varied manufactures were valued at approximately \$231,000,000 in 1929. Among the manufactures are many nationally known products, including radios, steamships, soups, pens, linoleum, leather goods, pharmaceuticals, gas mantles and textiles. In 1929 the retail trade amounted to \$54,135,819, and the wholesale trade proper to \$14,770,368. The site of Camden, originally known as Jacques Eylandt, was discovered by the Dutch Commander DeVries in 1631. In 1638 it was settled by a Swedish Colony and named Aquikanasra. Jacob Cooper laid out a town site in 1763 and named it after the Earl of Camden. Camden was the scene of considerable fighting during the Revolution and was occupied alternately by British and American troops. Camden was the home of **WALT WHITMAN**, and he is buried here in Harleigh cemetery. Whitman's old home is maintained by the city as a museum. The city was first incorporated in 1828 and reincorporated under a revised charter in 1871. Pop. 1920, 116,309; 1930, 118,700.

**CAMDEN**, a city and the county seat of Kershaw Co. in north central South Carolina; situated on the Wateree River, 30 mi. northeast of Columbia. Airplanes, bus lines and three railroads serve the city. The chief crops of the district are corn and cotton. Hospital gauze manufacture is the principal industry. Camden is a popular winter resort. Horse racing was reestablished recently on the old track dating back to 1861. The city was founded by Quakers in 1733. During the American Revolution Camden was in the possession of Cornwallis' forces and was the scene of the defeat of the Americans under General Gates in Aug. 1780. The British were again successful nearby at Hobkirk's Hill in 1781. Camden was visited by Lafayette and Washington. Pop. 1920, 3,930; 1930, 5,183.

**CAMDEN, BATTLE OF**, Aug. 16, 1780, a battle in the **REVOLUTIONARY WAR**, between an English force of 2,000 under Lord Cornwallis and a Continental force of 3,000 under Gen. Gates. To check the British advance in South Carolina, the Continental Congress despatched Baron de Kalb with 2,000 troops,

and, after the news of the surrender of Charleston, sent Gates, vastly overrated after the BATTLE OF SARATOGA, to take command of the Continental army in the South. Gates moved toward Camden, valuable as the junction point of several highways, but mismanaged the march, and attacked the British force at a time when his army was generally ill and exhausted. De Kalb was mortally wounded in the engagement. The Continental army was ignominiously routed with a loss, including the missing, of 1,000 men. The British loss was 225.

**CAMDEN (DELAWARE RIVER) BRIDGE**, the suspension structure over the Delaware River between Philadelphia, Pa., and Camden, N.J., construction of which began in Jan. 1921. It was completed in July 1926, at a cost of \$37,211,169, including that of land purchased for the approaches. Until the construction of the Ambassador Bridge, the Camden Bridge was the largest suspension structure in the world. The bridge with its approaches extends from Franklin Square, Philadelphia, to 6th and Penn Streets, Camden, a distance of 1.81 mi. The main span is 1,750 ft. in length, with a clearance above mean water of 135 ft. The span, 125½ ft. wide, providing room for a central roadway 57 ft. wide, together with four railroad tracks and two 10-ft. sidewalks, is supported by two main cables, each 30 in. in diameter and composed of 18,360 high carbon galvanized steel wires, 1.192 of an in. in diameter. The cables are 3,534 ft. long between the anchorages. The two towers rest on bed rock, and rise 385 ft. above high water. The bridge has a capacity of 6,000 vehicles per hour. The directing engineer was Ralph Modjeski.

**CAMEL**, a beast of burden the domestication of which antedates history. According to the Bible, Job's wealth included 6,000 camels. A few wild camels found in central Asian deserts are thought to be descendants of domesticated animals escaped from Gobi villages which were overwhelmed by sandstorms in the 17th century. The two living species, the Arabian or single-humped camel (*Camelus dromedarius*) and the two-humped or Bactrian camel (*Camelus bactrianus*) differ greatly.

The better-known Arabian is found from northwestern India to the extremity of Arabia and west as far as the African deserts extend. The female produces a single calf at a time, nursing it a year. A camel does not reach its full growth for 16 or 17 years, usually living about 50 years. Camel flesh and milk are used by the Arabs, and the long hair provides clothing and tent materials. The camel is peculiarly well-adapted to life in sterile or desert countries. It stores in its several false stomachs enough water to last for days; it eats tough, even thorny herbage. Long lashes protect its eyes; it can close its nostrils against flying sand. Its hump is a reservoir of fat which grows small and flabby as the animal draws sustenance from it. The broad, padded feet prevent sinking in sand where horses or automobiles are helpless. Some transport breeds are capable of carrying half a ton 25

mi. a day, while racing camels can easily cover 100 mi. in the same time. A camel corps is part of the British "cavalry," and an unsuccessful attempt was once made by the U.S. army to use camels in Arizona and New Mexico. Some were supposed to have run wild and bred in southwestern deserts, but these are now extinct. Though not as well-known as the dromedary, the Bactrian camel probably exists in larger numbers in Asia than does the Arabian in northern Africa. This camel is especially suited to colder climates and rockier roads. These smaller, sturdier camels can carry loads of 1,000 to 5,000 lbs.; caravans of several thousands are seen.

The camel is one of the ugliest and worst-tempered of animals. Though subject to man, it never yields to kindness, throwing or biting him at every opportunity. It will travel only if it must, and will not lift a load which it considers too heavy. The males become very vicious in the rutting season, when fights are frequent. Some Arabian tribes match trained fighting camels.

G. E. F.

**CAMEL HAIR** is obtained from the two-humped, long-haired Bactrian camel (see CAMEL), the principal beast of burden in Turkestan and Mongolia. The fleece is divided into two parts: (1) long overhair, rather coarse, measuring four in. long and about 0.075 in. in diameter, of a dark brown color, growing on the mane, haunches and humps; (2) the curly, wool-like underhair, much finer and softer, of a yellow, reddish or brown shade. It is exported "raw" (mixed) and separated by combing. The camel having been domesticated since 5000 B.C., the hair has long been employed for clothing, tents and other coarse fabrics. The manufacture of camel hair was restricted to Germany before the World War, but is now largely carried on in the United States and England, the coarse hair being used for carpets and belting, and the wool for light, warm, durable cloths for airmen's clothing, polar sleeping bags, dressing gowns, and linings. Owing to its pleasing brown color it is seldom dyed. Excellent imitation fur is made with a cotton back and a camel wool pile; this is used for coats and linings.

F. G. P.

**CAMELLIA**, the name given to a genus of evergreen shrubs and trees of the TEA family, native to tropical and subtropical Asia, several of which are very widely cultivated for their handsome flowers and foliage. *Camellia japonica*, usually a shrub, but sometimes a rather tall, gracefully proportioned tree, with shining dark green leaves and large red flowers, runs into many varieties with white, pale rose, and variously double flowers. *C. Sasanqua*, a straggling shrub, with dark shining leaves and small flowers, also runs into many variant forms. *C. reticulata*, a large smooth shrub, bears dull green foliage and huge, peony-like, purplish-rose blossoms, sometimes 7 in. across.

**CAMELOPARDALIS** (gen. *Camelopardalis*), the giraffe, a large constellation that fills the space between Auriga, Cassiopeia, Ursa Major and the north pole but contains only faint stars. See STAR: map.

**CAMELS, FOSSIL.** The evolution of the ancient camel race was accomplished in North America during a period approximating 3,000,000 years. Progress involved steadily increasing size, altered dentition, adaptation of foot-structure to desert conditions, and the union of leg bones, making for greater rigidity.



COURTESY AMER. MUS. OF NATL. HISTORY

SKELETONS OF MIOCENE CAMELS  
Found at Agate Springs, Nebraska

The tiny four-toed Eocene fossil cameloid was no larger than a jackrabbit. In the Oligocene slender camels the size of sheep, with small, pointed heads, long necks, and deerlike hoofs, abounded in the western United States. The Upper Micene found the extraordinary "giraffe camel" browsing on the tree-tops, and a grazing form, with distinctly camel-like feet (*Procamelus*), the probable ancestor of true camels and llamas. In the Pliocene flourished forms larger than any existing camel. Both large llama-like creatures and true camels roamed the Great Plains of North America until mid-Pleistocene times. Then, having spread the one into South America and the other northward into Asia, they gradually disappeared from North America.

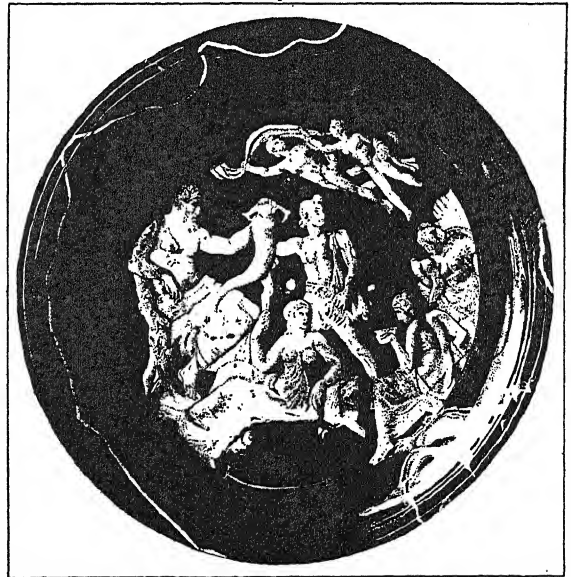
**CAMEO**, miniature sculpture in relief on a gem stone, usually on striated stone such as onyx, sardonyx, agate or molluscan shell, with the design in one layer of color and the background in another. Cameos are extensively used in brooches, finger rings and other articles of adornment. The first true cameos were cut in Greece in the 3rd century B.C., and the art reached its perfection under the Greeks and Romans. The "Tazza Farnese" now in the National Museum at Naples, a shallow dish cut from a single sardonyx, is the finest example of Alexandrian cameo cutting. Cameos produced from imitation substances known as pastes were also made by the ancients.

**CAMERA, PHOTOGRAPHIC**, fundamentally, a light-tight box with a lens, usually termed an objective, at the center of one end, a carrier for a sensitized plate or film at the other end and a shutter, a device for controlling the time during which the plate or film is exposed to the light. The objective forms the image upon the sensitive emulsion of the film or plate.

The shutter, which opens to admit the light into the camera, may be located between the components of the objective, in which case it is called a between-the-lens shutter. A focal-plane shutter consists of a curtain, carried on two rollers and mounted so as to travel in front of the film or plate. The curtain is wound from one roller to another by the action of a spring, and a slit in the curtain, while passing in front of the plate, permits the exposure to be made. With the focal-plane shutter, the duration of the exposure is governed by the rate of travel of the curtain and the width of the slit.

A portion of the camera body may be constructed like a bellows or of telescoping tubes so that the lens may be focused for objects at different distances. Cheaper cameras of the fixed-focus or box-type do not have this provision. A camera which folds up very compactly for carrying is termed a folding, or hand, camera. A view camera is less compact than the hand camera, but it is portable and carries a greater variety of adjustments. In the studio camera, no attempt is made to secure portability, but everything is arranged for stability and convenience of operation. A stereoscopic camera consists of two cameras mounted parallel to each other with the lenses separated by approximately the same distance as the eyes. Two pictures are taken simultaneously and these form the two halves of a stereoscopic print adapted to be viewed with a STEREOSCOPE.

I. C. G.



THE TAZZA FARNESE

**CAMERA LUCIDA**, an attachment for the Microscope which facilitates the sketching of minute objects. The sheet of paper on which the drawing is to be made is placed near the microscope in a convenient position. The camera lucida is a small prism or mirror system which is mounted on the eyepiece of the microscope in such a way that the observer, looking through the microscope, sees the object, apparently superposed on the sketch sheet.



**CAMERON, SIMON** (1799-1889), financier and public official, was born in Lancaster Co., Pa., March 8, 1799. He amassed a fortune in banking and industrial enterprises, maintaining at the same time an active interest in politics, and in 1845-49 served in the United States Senate as a Democrat. In 1854 he left the Democratic Party and two years later became head of the Republican Party in Pennsylvania. He was elected to the United States Senate in 1857 as a Republican, resigning in March, 1861, to enter Lincoln's cabinet as Secretary of War. Corrupt practices in his department led to his forced resignation in Jan. 1862. Lincoln then appointed him minister to Russia. Within a year he returned to the United States to resume control of the Republican machine in Pennsylvania as political "boss." He again sat in the Senate 1867-77, resigning to hand over the office to his son, James Donald Cameron. As an ardent believer in the spoils system, Cameron opposed all civil-service reforms, frankly using his own political power to gain and dispense patronage. He died at Donegal, Pa., June 26, 1889.

**CAMEROON**, the former German protectorate Kamerun, the territory on the west coast of Africa between Nigeria and French Equatorial Africa, extending from the Gulf of Guinea to Lake Chad. British and French troops occupied the protectorate during the World War. By the treaty of Versailles the region was divided between Britain and France under mandates, the greater portion being placed under French administration.

**British Cameroon.** This is a strip of 34,236 sq. mi. stretching along the Nigerian frontier. The surface of the land varies from coastal mangrove swamps and thick forest belts to grasslands at elevations of 4,000 to 7,000 ft. The volcanic Cameroon Range, active in 1922, towers above the port of Victoria to a height of 13,350 ft. British Cameroon's products are rubber, palm oil and kernels, cocoa and ivory.

The northern section of the region is administered by the resident commissioners of the adjoining Nigerian provinces of Adamawa and Bornu. The southern section is administered by the Nigerian government, the capital being Buca. The population, of Bantus and Sudanese, is 700,050.

**French Cameroon.** This section covers an area of 166,489 sq. mi., excluding the 107,207 sq. mi. ceded to Germany in 1911, which is now included in French Equatorial Africa. The coast receives a heavy rainfall, and has unhealthy mangrove swamps. There is little actual lowland except toward Lake Chad, where savanna conditions prevail. The extensive forests have much valuable timber, including mahogany. The principal products are palm oil and kernels, kola nuts, cocoa, rubber, tobacco and ivory. Yasunde is the capital and Duala the chief port. Pop. 1928, 1,900,000; this includes 2,009 Europeans, 1,638 of whom were French.

**CAMILLE**, the English title of a tragedy by DUMAS THE YOUNGER, *La Dame aux Camélias*. This eminently actable drama of Marguerite Gautier and

her love for Armand Duval, has been the vehicle of almost every noted actress since the time of its first production in 1852. Camille is also the name of the heroine of *Horace*, a play by PIERRE CORNEILLE, which appeared in 1640, based on a Roman legend, in which the love of man and woman is set against the love of family and country.

**CAMILLUS, MARCUS FURIUS**, early Roman magistrate and general. After defeating the Faliscans, Fidenates, and Veientes who had revolted from Rome, c. 394 B.C., and being accused of dishonest distribution of the booty captured, he went into exile. When a horde of Gallic invaders, after crushing the Romans at the Allia River, c. 390 B.C., had taken all Rome except the Capitoline Hill, Camillus was recalled as dictator, and hastily assembling an army, he defeated the Gauls and saved Rome. Hailed as a second ROMULUS he later won victories over the Aequi, Volsci and Etruscans, and repelled the Gauls again in 367 B.C.

**CAMISARDS.** The nickname given to those mountaineers of southeastern France who offered armed resistance to the revocation of the EDICT OF NANTES during the early years of the 18th century. The name is derived from the French *camisade*, an obsolete word of night attack, from *camisole*, *chemise*, a shirt. The movement had its inception in the writings of several Huguenot exiles in Holland, principally Pierre Jurieu whose two books *l'Accomplissement des prophéties* and *Lettres Pastorales* were widely circulated in France, though forbidden by the censor, during the years 1686-90. In these books was foretold the end of the domination of the Roman Catholic Church and the triumph of Protestantism. The English Revolution of 1688 seemed to many to bear out this prophecy, in spite of the formal refutation of Jurieu's arguments by Bishop Bossuet in *l'Apocalypse Expliquée* (1689). Violence was introduced into the controversy in 1702 with the assassination of the Abbé du Chayla as a protest against the Catholic priest's use of torture against the Protestants of the Cévennes. Roland, Cavalier, and Montrevel became the three leaders of the increasingly active population which succeeded in three years in driving away the clergy and destroying church property in many districts—the extermination of 466 villages in the Upper Cévennes being an instance on record. The guerilla fighters were made even more desperate by the bull Clement XI issued against them, promising absolution to those who would put down the "Execrable race of the ancient Albigenes." In 1704 an agreement was made between the leaders of the contending groups, which led to the granting of liberty of conscience and the right of assembly to the Protestants of the region. A few continued the war for a time, but the backbone of the opposition was broken. J. BA.

**CAMOËNS** or **CAMÕES**, LUIZ DE (c. 1524-80), Portuguese national poet, was born at Lisbon, probably in 1524. After being educated at Coimbra, he spent some time at the court of John III, until he fell in love with Catarina de Ataíde, and was banished.

He joined the army in Africa, where, in a naval engagement at Ceuta, he lost both the sight of his right eye and his handsome appearance. As the result of a brawl, he was imprisoned and banished to India. His ship weathered a fearful storm and anchored at Goa, on the Malabar Coast, India. The next 16 years of Camoëns's life were passed in the East, where he endured every kind of adversity. At this time he was writing his great epic, *Os Lusíadas* (see *THE LUSIAD*), on which his fame rests. Returning to Lisbon, he published the poem with indisputable success in 1572. He also published many notable lyrics. But Camoëns, suffering from extreme poverty and broken by hardship, lived apart and solitary. The final blow was the death of his faithful Javanese servant, who is reported to have begged to provide for his master's needs. Camoëns died in Lisbon, June 10, 1580.

**BIBLIOGRAPHY.**—Sir Richard Burton, *Camoëns: His Life and his Lusíadas*, 1881; A. F. G. Bell, *Louis de Camoes*, 1923.

**CAMORRA**, a Neapolitan secret society established to protect prisoners, but notorious for quite other practices through almost a century. The Camorra first became known about 1820, when the prisons of Naples were filled with victims of Bourbon misgovernment. Upon attaining their freedom, the prisoners thus aided held together in gangs, and the organization became a large underworld body, given to various crimes and finally to political activity and terrorization. The Camorra undoubtedly possessed elements of the picturesque; it demanded a novitiate and exercised strict discipline. Its members were in four grades from the gentleman robber to the thug, and they communicated with each other by an interesting system of signals.

The society became political after 1848 and from 1862 on determined efforts were made to suppress it. In 1899 the Italian government stepped in to put an end to the scandals in Naples, and in 1901 Camorrist candidates were generally defeated. Camorrist leaders were involved in a notorious murder in 1911, and the severe sentences imposed proved practically the death sentence of the society.

**CAMOUFLAGE**, any system intended to disguise and conceal the presence of a military work or installation from both ground or aerial observation, as well as to decrease its clearness as a target. The art of camouflage requires a knowledge of light and shade effects as observed directly or from the air.

A ship may be painted or "dazzle painted" to distort its normal appearance so that its actual course becomes a matter of doubt to the enemy, particularly, the enemy's SUBMARINES, the true course being needed in a modern attack.

Dazzle painting for ships came into use in the World War. Merchant vessels of slow speed especially needed protection. The juxtaposition of controlled colors was experimented with successfully within visibility limits. As a result of the experimentation, it was determined that the most suitable colors for successful camouflaging were black, white and blue.

These colors are particularly confusing when PERISCOPES are used. Over 4,000 merchant vessels of the Allies and several hundred smaller vessels of war were camouflaged by 1918.

**CAMP, WALTER CHAUNCEY** (1859-1925), American athlete and writer, was born in New Britain, Conn., Apr. 7, 1859, and graduated in 1880 at Yale. When he became associated with the New Haven Clock Company in 1883, he continued his activities in athletics at Yale. He became a leading authority on football and in 1889 began selecting annually the "All-American team," of the best men of the season in their respective positions. Camp, called the "father of football," was responsible in large measure for the growth of collegiate football in the United States, and developed the game from the English Rugby played when he was at Yale. In 1906 he devised the rule requiring a 10-yd. gain in 4 downs. During the World War he was consulted about physical drill in training camps and originated the exercises known as the "daily dozen." He was a prolific writer on sports subjects. He died in New York City, Mar. 14, 1925.

**CAMP**, a temporary housing for a military force during training, field operations or rest. Personal shelter is provided in field operations and marches by small canvas tents, halves of each being carried by individuals. For more fixed camps, large conical or square canvas tents carried in baggage trains are pitched. These tents house from four to eight men. For long periods, folding cots are provided and temporary wooden floors are laid.

In semi-permanent camps, or cantonments, the buildings are constructed of wood, usually in the form of long, low, single-story, thin-walled structures called barracks. Cantonments are usually for the purpose of mobilization and training.

**CAMPAIGN**, a series of related military operations by a large field force occurring in a single season or pertaining to a given region, constituting a distinct phase in a war. Examples are the Peninsular Campaign during the Civil War and Mazurian Lakes Campaign during the World War. In theory a campaign begins with a definite objective and ends with its accomplishment or failure.

**CAMPAIGN, POLITICAL.** In England the political campaign coincides with a general election of members of the House of Commons, and promptly follows a dissolution of PARLIAMENT. As the King dissolves Parliament on the request of the Prime Minister, a general election may come at any time.

In France the campaign takes place in elections of members of the Chamber of Deputies in the spring of every fourth year, as 1924, 1928, 1932. In the United States the campaign centers about the nomination of candidates and election of the President and Vice-President. The campaign is first for the nomination of the Party which is made at a National Convention, (see *CONVENTION, POLITICAL*), usually in June. It then becomes a contest between the nominees. The parties are elaborately organized, with a

national chairman at the top and committees for nation, states and localities. The means of persuading voters are numerous—mass meetings, parades, distribution of campaign literature, newspaper articles and editorials, public addresses by candidates and by thousands of campaign speakers. In 1928, radio-speaking proved a powerful means of campaigning.



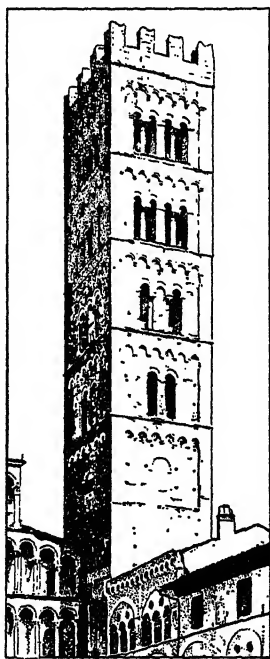
THE EARLIER CAMPANILE OF THE CHURCH OF SAN AMBROGIO, MILAN, ITALY

**CAMPANELLA**, TOMMASO (1658-1639), Italian Renaissance philosopher, was born near Stilo in Calabria, Sept. 5, 1568. When but a boy he joined the Dominicans. During the Calabrian revolt of 1598 against Spanish tyranny, Campanella became implicated in the cause of the rebels. For this he was sentenced to prison, where he remained for 27 years.

While in prison he wrote the *Civitas Solis*, his best known work. His main philosophic treatise, *Philosophia sensibus demonstrata*, appeared in 1591. Campanella died in Paris, May 21, 1639.

Philosophically Campanella revolted against authority and, like Bacon, believed in going to nature rather than books to find truth. His *City of the Sun* is one of the well-known Utopias. In it is pictured a city situated on a lofty peak overlooking an expansive plain. Its inhabitants are blessed with neither riches nor poverty. Communism is in vogue and emphasis is placed upon the productive aspect of work.

**CAMPANILE**, an Italian bell tower. Bell towers came into use gradually from the 9th century on. The most primitive types are simple square or cylindrical towers, like those of San Apollinare in Classe and San Apollinare Nuovo in Ravenna that are variously attributed to the 9th or 11th centuries. Square campaniles of primitive type are St. Giovanni Evangelista, in which the spire is probably a later addition, and San Pier Maggiore, both at Ravenna, and of the late 9th century. In these, as in the round towers, there are many small arched win-



CAMPANILE OF THE CATHEDRAL, LUCCA, ITALY

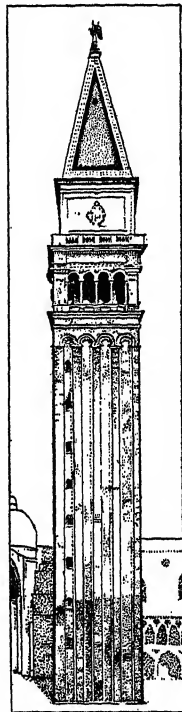
dows, grouped in twos and threes. Colonnets separate the openings of each group, and the thickness of the supported masonry forces the use of a spreading bracket capital with its long dimension across the wall. There are also occasional string cornices or cornices, dividing the towers into stages. In the early square campanile of San Ambrogio, Milan, 9th century, an even simpler scheme is found, with single arched openings. In all these early campaniles the roofs are low and are not seen from the ground.

Later campaniles can be divided into three general classes, characteristic of Rome, central and northern Italy, and Venice and cities under Venetian influence. The Roman types are the richest. Bold cornices with brackets and dentils divide the height into well-marked and nearly equal stories. The lower stages frequently have wall arches, unpierced; the upper, grouped windows. The emphasis is horizontal, and in molding profiles and ornament there is much classic influence. Characteristic examples are those of Santa Maria in Cosmedin, 12th century, San Giorgio in Velabro, 12th century, San Eusebio, 12th century, and Santa Pudenziana, 12th century, all in Rome.

The second type was developed largely under Lombard influences, and is decorated with vertical buttress strips, occasional long engaged column forms, and arcaded cornices; the emphasis is vertical. The Canon's Tower at San Ambrogio, Milan, 1128, is characteristic; its horizontal arcaded band courses are stopped by the corner buttress strips, so that the vertical lines are much accented. The 13th century campanile of Parma Cathedral shows the same vertical emphasis, but the spire and corner pinnacles are Venetian in style. Other examples that show the type are those of San Frediano, Lucca, 13th century, and Santa Maria at Pomposa, 11th century.

The Venetian type accents the height by carrying up the tower almost unbroken to an upper stage that is kept light and open, and crowning the whole with a pyramidal or conical spire, often with pinnacles at the corners. It is shown in the tower of the Cathedral at Piacenza, and in the top of that of Parma Cathedral. In Venice itself the type persisted well into the Renaissance, as in the church of San Giorgio Maggiore. The most famous example, the Campanile at Venice, early part of 10th century and reconstructed 1905-11 after its collapse in 1902, is 325 feet high to the top of the spire. All of these Italian church campaniles were usually entirely separate from the church edifice.

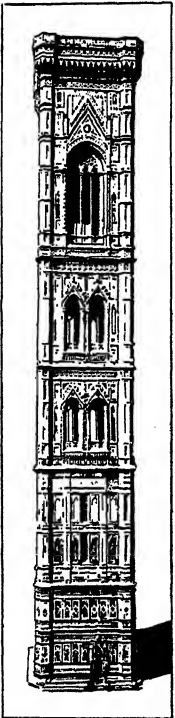
Two campaniles stand out from the ordinary classes,



THE CAMPANILE OF ST. MARK'S, VENICE

those of the Pisa and Florence cathedrals. The Pisa example, the famous Leaning Tower, begun in 1174, has six stories of free standing circular arcades around the cylindrical drum. The lowest stage has wall arcades; in the topmost stage the arcade is omitted and the drum itself pierced. The structure began to lean while still under construction, due to the settlement of the foundations, and attempts to correct the lean were made by varying the heights of the arcades. The lean has greatly increased since the tower's completion, and unless the foundations are consolidated anew, the final collapse is inevitable.

The Campanile in Florence, 275 feet high, is one of the few Italian towers in the pure Gothic style. Designed by Giotto, Andrea Pisani and Francesco Talenti, and built 1334-87, it has a composed richness, both of colored materials and of carved ornament, a tightness of composition and a combined strength and delicacy of design, that make it one of the finest towers in the world.



GIOTTO'S CAMPANILE, FLORENCE, ITALY

The bell towers, often of great height, that form part of the Italian town halls are also known as Campaniles. They are usually built on the front face of the building, and are frequently fortified with projecting machicolations and battlements. Those of the Palazzo Vecchio, 1298-1314, in Florence, and of the Palazzo Pubblico, 1288-1309, at Siena, 395 feet high, are typical. T. F. H.

**CAMPANINI, CLEOFONTE** (1860-1919), Italian conductor, was born at Parma, Sept. 1, 1860. He studied music at the Royal Conservatory at Parma. In 1883 he was appointed assistant conductor of the Metropolitan Opera, New York. He conducted opera in Italy, Spain, and South America, going to Covent Garden, London, in 1900. In 1906

he was engaged by Oscar Hammerstein as conductor of the Manhattan Opera, New York, and in 1910 became conductor of the Chicago Opera Company, of which he was made general-director in 1913. His noteworthy productions at Chicago included *Salome*, *The Secret of Suzanne*, and *Monna Vanna*. He married Eva Tetrazzini, the sister of Luisa, in 1887. He died at Chicago, Dec. 19, 1919.

**CAMPANULA**, a genus of numerous handsome plants of the bell-flower family, comprising some 250 species, mostly perennial herbs bearing white, blue or lilac bell-shaped flowers, native chiefly to the Northern Hemisphere. About 20 species occur in the United States: among them the tall bell-flower (*C. americana*), 6 ft. high, with long dense clusters of shallow blue flowers; the hare-bell or bluebell (*C. rotundifolia*), with small drooping flowers; and the delicate Cali-

fornia bell-flower (*C. prenanthoides*). The bell-flowers are of easy cultivation, many species and varieties being grown in gardens; the dwarf forms do excellently in pots, and also rockeries and borders.

**CAMPBELL, ALEXANDER** (1788-1866), leader in the establishment of the religious body known as DISCIPLES OF CHRIST, was born in County Antrim, Ireland. He received his early education chiefly in a school conducted by his father, Rev. Thomas Campbell, spent one year in the University of Glasgow during which he became dissatisfied with conditions in the Seceder Presbyterian Church of which he was a member, and came to America in 1809. His father had preceded him and settled in southwestern Pennsylvania. The son soon took the lead in a reformatory movement started by the father, urging the union of all Christians by the "restoration of primitive Christianity." He edited and published *The Christian Baptist*, 1823-29, and *The Millennial Harbinger*, 1830-62, and was the author of *The Christian System*, *Christian Baptism*, and other books. He was a member of the Virginia constitutional convention, 1829; made many trips north, south and as far west as Missouri in the interest of the Disciples; and acquired wide reputation as a debater by five oral discussions: with Walker, 1820; Maccalla, 1823; the infidel Robert Owen, 1829; the Roman Catholic Archbishop Purcell, 1837, and the Presbyterian N. L. Rice, 1843. Campbell established Bethany College, 1841, at his home, Bethany, W. Va., and served as its president for 20 years. He was president of the American Christian Missionary Society from its organization in 1849 until his death in 1866. At the time of his death the Disciples of Christ numbered about 300,000. W. E. G.

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**CAMPBELL, SIR COLIN, Lord Clyde** (1792-1863), British soldier, was born at Glasgow, Oct. 20, 1792, the son of a workman. From 1808 to 1813 he served with the British army in Spain during the Peninsular War. From 1841 to 1852 he was assigned to China and then to India. During the Crimean War in 1854-56, he saw service as commander of the Highland Brigade in the battles of Alma and Balaklava, being made major-general and knighted. He returned to India as lieutenant-general in command of the British forces at the time of the SEPOY MUTINY (1857). He was personally in command at the recapture of Cawnpur and the relief of Lucknow. For his services he was given the rank of general, created a peer, and in 1862 made a field marshal. Campbell died at Chatham, Aug. 14, 1863.

**CAMPBELL, MRS. PATRICK** (1865- ), English actress, née Beatrice Stella Tanner, was born at London, Feb. 9, 1865. When 17 she married Patrick Campbell (d. 1900), and in 1914 George Cornwallis-West. Her first professional appearance was made in Liverpool in 1888 as Sophia Moody in *Bachelors*. By

1893 she was known throughout England as a competent actress but the triumph she achieved in May of that year in the first-night performance of Pinero's *The Second Mrs. Tanqueray* brought her widespread fame. She played with J. FORBES-ROBERTSON in Shakespearean dramas in 1895-98 and later appeared in the United States in *Magda* and *Hedda Gabler*, and in 1914 made a notable success in G. B. Shaw's *Pygmalion*. In 1904 she played with SARAH BERNHARDT in *Pelléas et Mélisande*. She published *My Life and Some Letters* in 1922. In 1931 she appeared in New York City in *The Sex Fable*.

**CAMPBELL, THOMAS** (1777-1844), Scottish poet, was born at Glasgow, July 27, 1777, and was educated at the University of Glasgow. His *Pleasures of Hope*, a didactic work published in 1799, was immediately successful. His war lyrics, *Hohenlinden*, *Ye Mariners of England* and *The Soldier's Drama*, resulted from a tour abroad, as did also *The Exile of Erin*. Campbell helped to found the University of London, and was three times elected Lord Rector of Glasgow University. His fame rests principally upon his war lyrics. He died at Boulogne, France, June 15, 1844.

**CAMPBELL, WILLIAM WALLACE** (1862- ), American astronomer and president of the University of California, was born on a farm in Hancock Co., Ohio, Apr. 11, 1862. Graduating from the University of Michigan (1886), he taught astronomy there from 1888 to 1891, when he went to the Lick Observatory as astronomer, becoming director in 1901. He conducted eight eclipse expeditions from 1898 to 1923 and in the latter year became president of the University of California. He wrote numerous papers upon eclipse phenomena, comet orbits, and nebular spectra and two books, *Elements of Practical Astronomy*, 1899, and *Stellar Motions*, 1913.

**CAMPBELL**, a city adjacent to Youngstown, O., on the east, in Mahoning Co., on the Mahoning River. The Pittsburgh & Lake Erie and Baltimore & Ohio railroads serve the city, which is chiefly important for its iron and steel industries. Campbell is expanding both as a residential and a manufacturing community. In 1929 the retail trade amounted to \$2,593,815. It was incorporated in 1914 under the name, East Youngstown, but changed to Campbell in 1926. Pop. 1920, 11,237; 1930, 14,673.

**CAMPBELL-BANNERMAN, SIR HENRY** (1836-1908), British statesman, was born at Strathathro, Scotland, on Sept. 7, 1836. He received his education at the University of Glasgow and at Cambridge. After being returned to parliament for Stirling Burghs in 1868, he served in the war office, 1871-74 and 1880-82, as secretary to the admiralty, 1882-84, and chief secretary for Ireland, 1884-85. His success in Ireland was caused by his policy of non-intervention in Irish affairs. He was secretary of war in Gladstone's cabinet of 1886 and in the government of 1892-95. He was knighted in 1895. In 1898 he succeeded to the leadership of the House of Commons, which he held through the Boer War, which

he opposed, the campaign for free trade, and the argument over Home Rule for Ireland. With the resignation of the Unionist Government in 1905 Campbell-Bannerman became prime minister, and remained in office until Apr. 5, 1908. During his period of service he kept his party united in spite of his enforced absence from the Commons and his failing health during 1907. He died on Apr. 22, 1908.

**CAMPBELLTON**, a town in Restigouche Co., New Brunswick, Canada, beautifully situated on Chaleur Bay, at the head of navigation in Restigouche River, about 225 mi. northwest of St. John. Commercial interests center in pulp-making, lumbering, fishing, and woodworking. Lying as it does in good fishing and hunting country, Campbellton also is a summer resort, especially visited by sportsmen. Across the river is a village of the Micmac Indians. Pop. 1921, 5,570; 1931, 6,505.

**CAMP CIRCLE**. The camp was formally organized among the nomadic, buffalo-hunting Indians of the Great Plains of North America during periods when the whole tribe gathered for ceremonies like the sun dance or on the occasion of the annual hunt. The camp was formally organized. The tipis were arranged in a large circle or, as frequently happened, in a series of concentric circles, in which each band, gens or clan had an assigned position. At the center of the circle, often a quarter of a mile or more in diameter, which was open at the east, was the council tipi, and at other fixed points were those of the so-called "soldiers," as the police were called.

**CAMPECHE**, a state of Mexico, situated in the Yucatán peninsula, with an area of 18,089 sq. mi. Most of the state is a low coastal plain, rising in the southeast to low mountains, covered with dense forests of log-wood and many other varieties of tropical trees. The soil is thin and suited only to the growth of desert plants. The climate is hot, and in places very malarious. The Laguna de Terminos, fed by numerous small rivers, is a sweet water lake, and the only one of importance in the state. The lakes and rivers are teeming with fish and alligators, and the forests harbor myriads of beautiful birds. The capital of the state is Campeche, one of the oldest towns in America. Other towns are Carmen, Lerma and Concepcion. Pop. 1921, 76,419; 1930, 84,971.

**CAMPECHE**, a port city of Mexico and capital of the state of Campeche, situated on the Bay of Campeche, in the peninsula of Yucatan, about 90 mi. southwest of Mérida. The former prosperity of Campeche has left its mark in the arrangement of the city and its handsome buildings. Ruins of walls, 8 ft. thick, are relics of defenses against the buccaneers of the Spanish Main. Campeche was founded by Francisco Montejo in 1540, and is one of the oldest towns in America. It is now of little importance commercially since large ships cannot come into the harbor, but must anchor outside. It still exports hides, tobacco, cotton, logwood, native cigars, wax and salt. Pop. 1921, 16,938; 1930, 24,071.



**CAMPERDOWN, BATTLE OF**, Oct. 11, 1797, an engagement of the FRENCH REVOLUTION, between the Dutch fleet under Admiral de Winter and the British fleet under Admiral Duncan. The English learned that the Dutch ships were sent to protect a French force landing in Ireland and they set out to intercept them. Duncan broke the Dutch with two lines of his own ships and won a complete victory, capturing the flagship and seven others, besides taking about 6,000 prisoners.

**CAMP FIRE GIRLS**, a world-wide society of girls from 10 to 18 years of age, founded in 1912 by Dr. and Mrs. Luther Gulick. Its law is to "seek beauty, give service, pursue knowledge, be trustworthy, hold on to health, glorify work, be happy." Local groups may be organized with as few as 6 but not over 20 members, with a woman over 18 years of age as guardian. The central governing group is the national council. The society has three ranks, wood-gatherer, firemaker and torchbearer, which are attained progressively as a reward for accomplishment of definite tasks in the seven crafts, home, health, camp, nature lore, hand, business and citizenship. Each member's progress in these ranks is pictured symbolically in decorations on a ceremonial gown. The symbolism of Camp Fire ceremonies and regalia is derived from the North American Indian. Membership in 1930 totaled 236,643, including groups all over the United States and in 14 foreign countries.

**CAMPHOR**, a white, somewhat volatile solid ( $C_{10}H_{16}O$ ), melting at  $175^{\circ}C$ , and having a characteristic, penetrating odor. Natural camphor is obtained by steam distillation of the wood of the camphor tree, found mainly on the island of Formosa. The yield is about 4% of the weight of the wood. At present, considerable synthetic camphor is produced from oil of turpentine, which contains 70 to 90% of pinene, as pinene hydrochloride and camphene. The most important use of camphor is in the making of celluloid. Camphor is not, as sometimes believed, used in explosives.

In medicine, camphor is used hypodermically to stimulate circulation and respiration following collapse. Locally it is applied in the form of spirits of camphor, chiefly as a lotion or for the psychic effect due to its odor.

**CAMPOR TREE** (*Cinnamomum Camphora*), the source of gum camphor, a stout, dense-topped tree of the LAUREL family, native to China and Japan and widely cultivated in warm climates. It grows about 40 ft. high, with smooth, shining, pointed leaves, exhaling when bruised a strong camphor odor. The small yellow flowers, borne in axillary clusters, are followed by one-seeded, berry-like fruits. The tree is widely planted for ornament, especially along roadsides, from central Florida, where it has sparingly run wild, to southeastern Texas, and also in southern California.

**CAMPINAS**, a city of Brazil, in the state of São Paulo. It is connected with SANTOS, 115 mi. distant by railroad. Campinas lies in a shallow valley of the

central plateau of the republic, and receives drainage from the surrounding slopes. It is the center of the coffee trade, and does an extensive business in other agricultural products. Pop. 1920, 115,000.

**CAMPING**, living in a tent or other temporary shelter, away from and without the conveniences of civilization. Camps may be temporary or permanent, the latter being equipped usually with log cabins or other buildings. Many automobilists on camping trips sleep in their machines or have a well-equipped trailer attached. Camping should be solid enjoyment, for "roughing it" does not necessarily mean discomfort. The experienced camper can carry into the woods on his back everything he will need for two weeks or more. For parties of four or more the necessary large tents cannot well be carried. Four people require a tent at least 10 by 12 feet. The wall tent and the conical Sibley type are most practical. The regulation Sibley tent will accommodate eight men. For two people, the standard "pup" tent is practical. It is made in two pieces, and no stakes need be carried.

A tent should be pitched to face the morning sun. It should not be placed where trees may blow down on it nor where the sun cannot reach and dry it after rain. Good drinking water and firewood should be near. For a stay of any length, a drainage ditch should be dug around the tent. The prime requisite for a camper is his bed. There are scores of sleeping bags, pneumatic mattresses and similar articles; but many sportsmen scorn these for beds of fragrant evergreen branches. Whatever is used, the bed must be dry and must be built over carefully smoothed out ground to be comfortable.

The food carried will depend almost entirely on whether fresh vegetables, eggs, milk and similar supplies can be obtained from nearby farms. In general, the rule is to carry nothing from home that can be obtained nearer the camp. Packsacks, knapsacks, blanket rolls, duffle bags and other carrying equipment are made in countless designs, each camper having his own preference. A favorite of experienced woodsmen is the Adirondack pack basket, which holds a lot, yet balances and carries well. When camping trips include fishing or hunting, each sportsman will have his own special choice of equipment. This is also true of camp ax and hatchet, hunting knife, flashlight, canteen and similar personal equipment. On even short trips, a first-aid kit should be taken.

Woolen clothing is best as it absorbs perspiration, and even when wet keeps the body warm. Cotton and silk get clammy and cause colds or rheumatism. All wool clothing shrinks and should be washed before starting. Everything should be loose; a tight garment may cause hours of misery. Footgear is most important, and a soft shoe pac or moccasin top-boot, ankle high, is best. Woolen socks or stockings should always be worn. The most successful camping trip is planned several months ahead. Each detail should be planned carefully, an exact list of every item absolutely needed being made, and non-essentials omitted.

See H. Kephart, *The Book of Camping and Woodcraft*.

**CAMPION, THOMAS** (1567-1620), English poet and musician, was born at London, Feb. 12, 1567. He went to Cambridge and in 1606 became a physician. He wrote madrigals, court masques with music, and critical works. Campion's fame rests on his lyrics, but it was obscured for a time by Puritan influence. His collected works, however, published in 1889, established him as one of the leading song writers of his time. He died at London, Mar. 1, 1620.

**CAMPOBASSO**, a city of Italy, capital of the province of the same name in the southern part of central Italy, in lat.  $41^{\circ} 34' N.$ , long.  $14^{\circ} 40' E.$ , situated on the slope of a hill crowned by a ruined castle, near the valley of the Biferno. It has manufactures of cutlery and trades in agricultural products. Pop. 1931, 27,402.

**CAMPO FORMIO, TREATY OF**, Oct. 27, 1797, a treaty which ended the war between the French Republic and Austria which had begun on Apr. 20, 1792. In the negotiations preceding the treaty Bonaparte was determined to gain such terms as would allow him to complete his reorganization of northern Italy and to engage upon his eastern project. But to gain those terms he had to make concessions concerning the left bank of the Rhine. Accordingly the final terms of the treaty confirmed the French annexation of the former Austrian Netherlands, recognized the existence of an enlarged Cisalpine Republic in Lombardy, and gave to France the former Venetian islands of the Levant, the Ionian Isles. But in compensation Austria received Venetia as far as the Adige River, Istria and Dalmatia, and agreed, in secret articles, at the general peace with the Holy Roman Empire to cede to France that part of the Rhine boundary from Switzerland to approximately the confluence of the Rhine and the Main, provided that the dispossessed German princes would receive compensation elsewhere within the Empire. This peace committed France to a policy of interference in German affairs and to the defense of Bonaparte's Italian system. It was not alone a sorry ending to the revolutionary crusade of 1792, but it was also a call to a new war.

**CAMPOS**, a city in the state of Rio de Janeiro, Brazil, on the Parahyba River. It lies 30 mi. from the coast, and its port is Imbetiba, 60 mi. distant. Coastal lakes and canals afford adequate transportation for the export of sugar which is produced in the fertile region near by. Pop. 1920, 175,850.

**CANAANITE**, a SEMITIC language-group spoken in early times in Syria and Palestine, and the source of Phoenician, Moabite, and Hebrew (*see* separate articles on these subjects). From the evidence of these dialects and a few glosses in the Tel-el-Amarna letters (1400 B.C.), its peculiarities, as compared with the other groups, are the change from *a* to *o*, and the use of "waw-consecutive," found only in Biblical Hebrew and Moabite.

**CANADA**. The Dominion of Canada comprises the northern portion of North America and its islands, with the exception of Alaska, Greenland, the small

islands of St. Pierre and Miquelon, and Newfoundland which, with the coast of Labrador, forms a separate British Dominion. The northern extremity of the mainland is in approximately latitude  $70^{\circ} 20'$ ; the northernmost known land extremity is in latitude  $82^{\circ} 40'$ . Thus about one-seventh of the land area lies north of the Arctic Circle. In the south, the Dominion extends to latitude  $49^{\circ}$  in the west and center, reaches its southern extremity, Middle Island in Lake Erie, in latitude  $44^{\circ}$  in the Maritime Province.

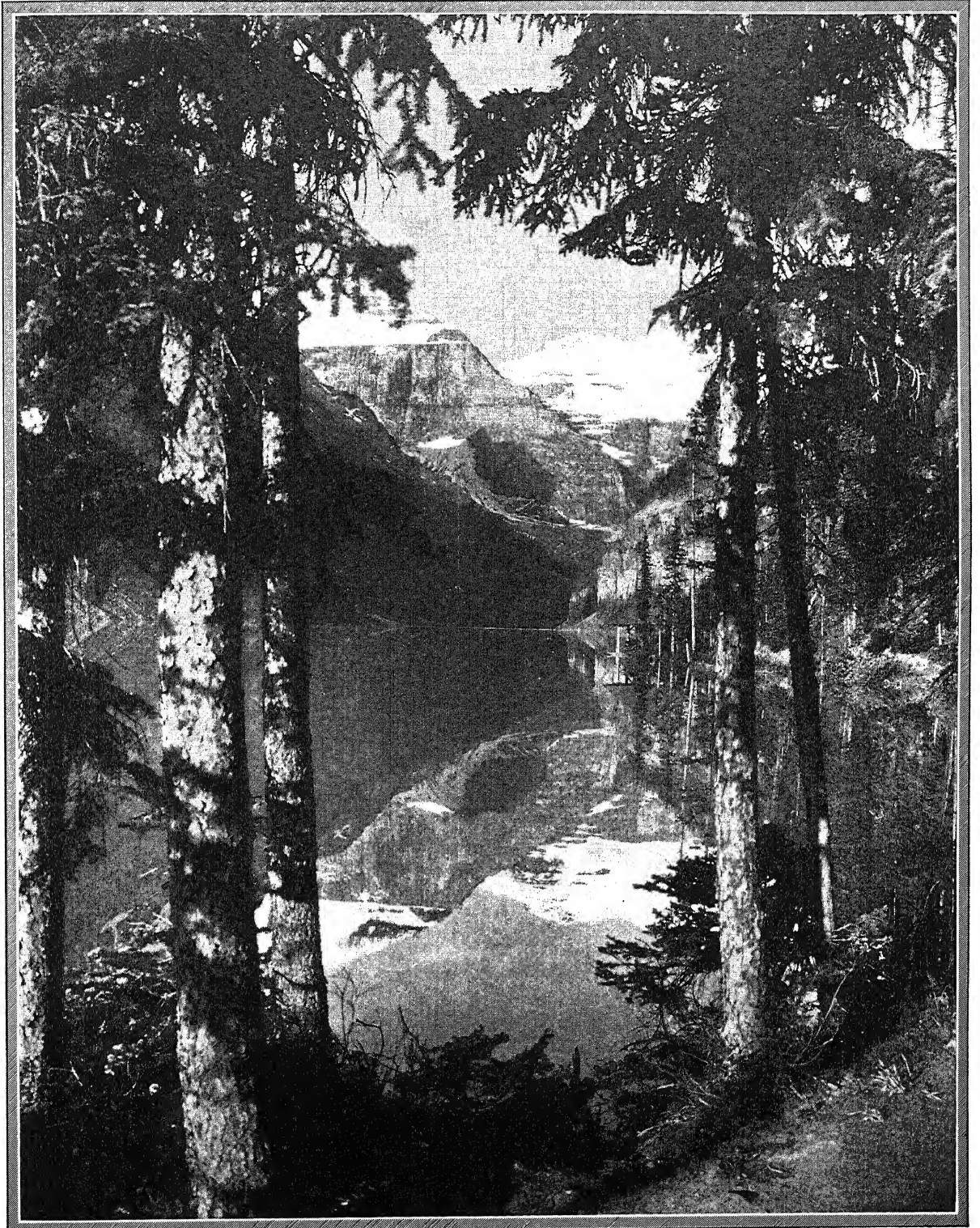
**Boundaries.** From the mouth of the St. Croix River on the Bay of Fundy, the international boundary line, about 3,260 mi. long, proceeds via various watersheds around the State of Maine to Stanstead, and thence to Cornwall on the St. Lawrence. Crossing the river, the line proceeds through lakes Ontario, Erie and Huron to the mouth of Pigeon River on Lake Superior. From there it passes along a chain of rivers and lakes to the Lake of the Woods in Ontario, and then along  $49^{\circ} N.$  lat. to the Strait of Juan de Fuca in British Columbia. The western boundary is formed by the Pacific Ocean northerly to latitude  $54^{\circ} 40'$ , then the line determined by the Alaska Boundary Tribunal in 1898 to the 141st meridian of west longitude, thence the 141st meridian northerly. The Arctic Ocean forms the northern boundary. The eastern boundary is formed by Kennedy Channel, Kane Basin, Smith Sound, Baffin Bay, Davis Strait, the coast of Labrador, the Gulf of St. Lawrence and the Atlantic Ocean.

**Area.** The land and water (142,674 sq. mi.) area of Canada totals 3,684,723 sq. mi., being about 3% larger than that of the continental United States with Alaska. The distance due north from the 49th parallel at the Lake of the Woods to the most northerly extremity of the mainland is about 1,578 mi. From Halifax on the east to Vancouver on the west is a distance of 3,772 mi. by rail.

**Physical Features.** The surface features of Canada are primarily a northward extension of similar features in the United States, particularly the lofty mountain mass of the west, the mountainous section in the east, and the central plains. The country may be divided into six natural regions: the Canadian shield, the St. Lawrence region, the Arctic archipelago, the Maritime or Appalachian region, the Pacific Coast region and the interior plains.

**The Canadian Shield.** The extent of this area in Canada is estimated at 1,825,000 sq. mi., while another large area extends into United States territory. The Canadian portion of the shield is usually from Three Rivers on the St. Lawrence, across Ontario to Georgian Bay, then along the northern shores of the lakes to the Lake of the Woods. From there it extends along the international boundary, ascends the eastern shores of Lake Winnipeg to the northern extremity of the lake, then through Great Slave and Great Bear Lakes, along the eastern side of the Mackenzie River to the Arctic. The remainder of the boundary is formed by the Hudson Bay lowlands, the Arctic islands, the coastal strip of Labrador,

## CANADA

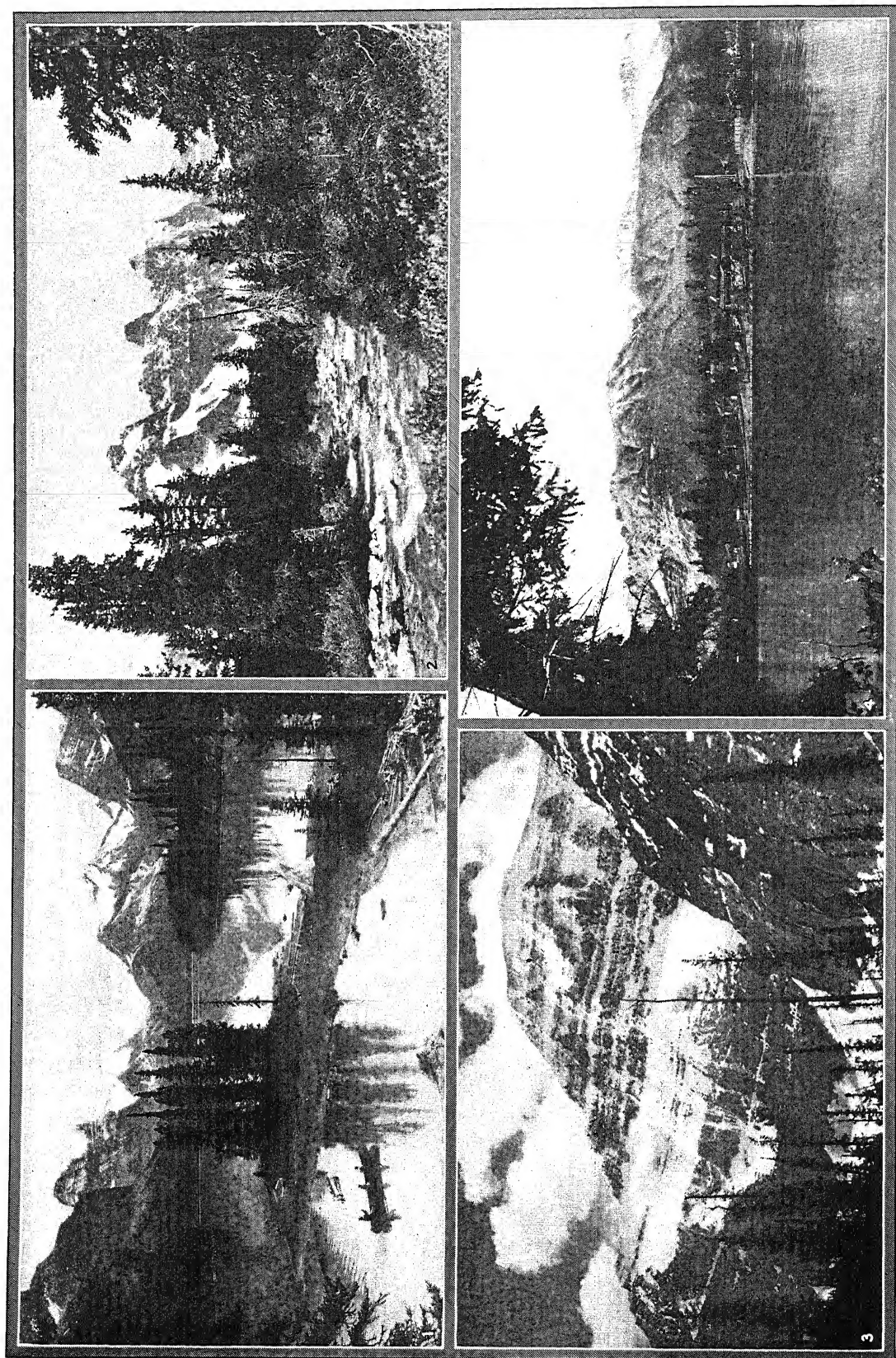


COURTESY CANADIAN PACIFIC RAILWAY CO.

### BEAUTIFUL MOUNTAIN-RIMMED LAKE LOUISE

Lake Louise, entirely surrounded by pine-clad mountains and fed by glacial waters, lies high in Rocky Mountain National Park, near Banff, Alberta.





# GRANDEUR OF MOUNTAIN SCENERY IN WESTERN CANADA

Four superb views of Jasper National Park, a wilderness of 5,300 sq. mi. in Alberta. 1. Maligne Lake. 2. The Ramparts. 3. Mount Edith Cavell, 11,300 ft. above sea level. The peak dominates the Athabasca Valley. 4. Jasper Park Lodge from Lac Beauvert.





DOMINION OF CANADA

Ar. 3,794,723 sq. m.  
Pop. . . . 10,374,196

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)

Pop.—Thousands

7 Amherst. N 22  
14 Belleville. P 19  
17 Brandon. O 11  
10 Brockville. P 19  
5 Buckingham. O 19  
84 Calgary. . . N 6  
7 Campbelltown. M 21  
12 Charlottetown. M 23  
15 Chatham. R 17  
4 Chatham. M 22  
12 Chicoutimi. M 20  
4 Dauphin. N 11  
4 East Angus. O 20  
79 Edmonton. L 7  
26 Ft. William. O 14  
9 Fredericton. N 22  
21 Guelph. . . Q 17  
59 Halifax. . . N 23  
156 Hamilton. Q 18  
29 Hull. . . . O 19  
7 Kenora. . . . O 12  
23 Kingston. P 19  
8 La Tuque. N 19  
13 Lethbridge. N 7  
12 Lewis. . . . O 20  
71 London. . . . Q 17  
10 Medicine Hat. N 7  
4 Megantic. O 20  
4 Melville. N 10  
21 Moncton. N 22  
819 Montreal. O 19  
21 Moose Jaw. N 9  
7 Nanaimo. N 3  
6 Nelson. . . . N 5  
18 New Westminster. N 3  
19 Niagara Falls. Q 18  
6 North Battleford. M 8  
16 North Bay. O 17  
9 North Vancouver. M 4  
127 Ottawa. O 19  
13 Owen Sound. P 17  
9 Pembroke. O 18  
22 Peterboro. P 18  
7 Portage la Prairie. N 11  
20 Port Arthur. O 14  
10 Pr. Albert. M 9  
6 Pr. Rupert. K 2  
131 Quebec. N 20  
53 Regina. . . . N 9  
8 Riviere du Loup. M 20  
43 Saint John. N 22  
43 Saskatoon. M 8  
23 Sault Ste. Marie. P 16  
15 Shawinigan Falls. . . O 20  
29 Sherbrooke. O 20  
10 Sorel. . . . O 20  
19 Sudbury. O 17  
5 Swift Current. N 8  
23 Sydney. . . M 23  
4 The Pas. M 10  
631 Toronto. Q 18  
8 Trail. . . . N 5  
8 Truro. . . . N 23  
245 Vancouver. N 3  
39 Victoria. . . N 3  
5 Weyburn. O 9  
63 Windsor. R 17  
23 Winnipeg. O 11  
11 Woodstock. N 21  
7 Yarmouth. O 22  
5 Yorkton. N 20

NEWFOUNDLAND AND LABRADOR

Area 155,134 sq. m.  
Pop. . . . 275,888

PRINCIPAL CITIES

Pop.—Thousands  
(Including Figures from Latest Population Estimates)

4 Harbor Grace. K 25  
36 St. John's. K 25

RAND McNALLY  
POPULAR MAP OF  
DOMINION OF CANADA  
AND  
NEWFOUNDLAND

SCALE 1:18,058,000

1 Inch = 255 Statute Miles

1 Centimeter = 151 Kilometers

Statute Miles

200 100 0 200 400 600  
Kilometers

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the Arctic Ocean and the St. Lawrence River. The shield is an ancient mass of Archean formation with Huronian outcrops. The average elevation is about 1,500 ft. Within a short distance of the Atlantic there are elevations rising to as much as 6,000 ft. above sea level, while a considerable part of the land around Hudson Bay lies between sea level and 1,000 ft. The drainage system is unlike any found elsewhere in Canada. This is caused by the scarcity and uneven distribution of the soil, glaciation, and the irregularity of the rock floor. The streams of the region are usually short and winding, and lakes of all shapes and sizes are legion. A great portion of the shield is drained by rivers flowing into Hudson Bay, and other parts are drained by the Ottawa and Saguenay rivers flowing into the St. Lawrence.

**St. Lawrence Region.** The plains are level, agricultural lowlands. About 36,000 sq. mi. in area, they include the broad arrowhead shaped peninsula separating Lake Huron from Lake Erie, the land lying between Huron and the Laurentian Plateau, and that portion of the Province of Quebec which lies between the Laurentian plateau on the north and the Appalachian highlands on the south. The whole extent of the plains is well watered, although the rivers, with the exception of the Ottawa, are not very large. All flow into the St. Lawrence, and provide much valuable water power where these streams descend from the Laurentian highland.

**Arctic Region.** This may be divided into the Arctic archipelago and the Hudson Bay coastal plains. The archipelago is a cluster of rugged, ice-bound islands. It is an elevated tableland, dissected by broad depressions occupied by the Arctic Sea, which thus creates more than a score of islands ranging from 500 sq. mi. upwards in area. Victoria Island is 74,000 sq. mi. in extent, Ellesmere 76,600, and Baffin Island 211,000. The slope of the land towards Hudson Bay is very slight; therefore the land is poorly drained and swampy.

**Appalachian Region.** This consists of the Maritime Provinces of New Brunswick, Nova Scotia, Prince Edward Island and the southeastern part of Quebec. Occupying an area of about 93,000 sq. mi., it forms the northern end of the Appalachian highlands. The mountain system extends in a discontinuous range from the international boundary north-eastward. Three parallel ranges, known as the Notre Dame Mountains, form the southern part which does not rise much above 2,000 ft. over any great area, and sinks much lower towards Quebec. The Shickshock Mountains in Gaspé form a broad area from 1,000 to 3,500 ft. high, dominated by the Tabletop peak, 4,450 ft. But Gaspé is not mountainous in aspect: rather it is a rolling, densely wooded plateau, in which deep valleys have been carved by the rivers. The uplands of New Brunswick are rugged in places, plateau-like in others, and contain elevations up to 2,500 ft. In Nova Scotia, rocky highlands rise to 1,000 ft. The lowlands are well-watered by winding rivers. Prince Edward Island is a lowland area of

less than 500 ft. in elevation at its highest point. The coast line is greatly indented, and numerous lakes are to be found throughout the region.

**Pacific Coast Region.** This area extends from the foothills of the Rockies on the east to the Pacific Ocean on the west, and from the international boundary on the south to the Arctic Ocean. In the north lies the basin of the Yukon, an undulating plateau region bordered by mountain ranges. To the south lies a series of very long, high ranges of mountains in a north and south direction, all of crystalline rock. Between the ranges are great plateaus also crossed by mountains. The Rocky Mountains stretch from Alaska into the United States and have an average width of 60 mi., with many peaks ranging in height up to 19,539 ft. Great glaciers abound, most of which are now retreating. Low passes are not uncommon. The Purcell Range consists of elevations lower than the Rockies. Between the Purcell and the Selkirk ranges lies the Purcell trench occupied by Kootenay Lake and its tributary, the Duncan River, and also the Beaver River which flows north to join the Columbia. The Selkirks lie west of the Purcells, and are about 80 mi. in width. The next, the Gold Range, are about 60 mi. wide with maximum elevations of 8,500 ft. The Coast Range extends along the whole length of the Pacific boundary, and is over 100 mi. in width, but it has no higher elevation than 9,000 ft. It will thus be seen that the heights of the various ranges have a tendency to decrease westwards. Between the Gold and Coast ranges lies the 800 mile-long interior plateau of British Columbia. On the Pacific side, most of the coast mountains fall steeply towards the sea; as a result, a fiord coast line, containing inlets over 30 mi. in length, has been formed. The continental shelf of the Pacific Coast was formed by the subsiding of a range of mountains, portions of which remain above sea level as islands. Of these, Vancouver and Queen Charlotte islands are the most important. The drainage system of the region is very pronounced. There are two main lines of drainage, one parallel with and one transverse to the mountains.

**The Great Interior Plains.** This region, covering an area of 635,000 sq. mi., lies between the Pacific region and the Canadian shield. About 850 mi. wide at the international boundary, the region gradually narrows, being about 175 to 200 mi. at its narrowest width, and then expands slightly towards its northern limit, the Arctic Ocean, where it has a width of 325 mi. In the southern part where the rainfall is light, about 200,000 sq. mi. are almost treeless. Although the precipitation increases but little north of this region, the evaporation is much less and good forest growth appears. The drainage system consists of long rivers flowing into Hudson Bay, or by way of the Mackenzie River into the Arctic Ocean. In southern Alberta and Saskatchewan, about 20,000 sq. mi. lie within the basin of the Mississippi. Most of the rivers have carved deep, wide and steep-sided

trenches in the plains. Save for the river valleys and a few plateaus, the interior plains are either level or gently undulating. The southern part of the region may be divided into three prairie districts. On the east lies the Manitoban lowland, an area of 67,000 sq. mi. A level plain with an elevation of about 800 ft., the lowland forms part of the bottom of Lake Agassiz, a very large glacial lake of which the Winnipeg group of lakes are remnants. This district is separated from the second prairie district by the Pembina, Riding, Duck, Porcupine mountains and Pasquia hills. These are really a broken line of escarpments rising from about 200 to 1,000 ft. in height. The second prairie is a plain of about 105,000 sq. mi., diversified with low hills and deeply trenched rivers. The greatly varied soils consist almost entirely of glacial drift. The average height of the plain is about 1,800 ft. above the sea, but in places rises to 2,500 ft. The third prairie comprises 135,000 sq. mi. and is irregular in surface. It extends from the Missouri Coteau, a low rock escarpment west of Moose Jaw, to the foothills of the Rockies, and south of 54° N. lat. From this latitude northwards to Great Slave Lake, the Coteau becomes inconspicuous, and the treeless prairie merges into a forest region. Developed by the Mackenzie River, a low, heavily wooded plain about 30 mi. wide, extends from Great Slave Lake towards the Arctic. Along the lower course of this river and the shores of the Arctic lies a treeless region.

**Lakes and Rivers.** The lakes which Canada possesses or shares with the United States are the greatest in the world. The basin of the St. Lawrence, with the connected Great Lakes, affords a continuous waterway. Almost everywhere in the interior are rivers and lakes. In the prairie region and the northwest are the Saskatchewan River and the large lakes Winnipeg, Athabasca, Great Slave and Great Bear. The Nelson, Albany and Churchill rivers flow into Hudson Bay; the Mackenzie and Coppermine into the Arctic Ocean; and the Fraser, Skeena and Stickeen into the Pacific.

**Climate.** The climate as a whole is characterized by considerable variations due to the large land mass, diversified topography, large latitude extent, and proximity of portions of the area to water bodies. The lofty mountain mass of the west is probably the most important topographic feature, as it confines the tempering influence of the ocean to the west coast, which has the only true maritime type of climate. The interior which is open to the north for entrance of cold air from the arctic, is characterized by zero and sub-zero temperatures in winter and high temperatures in summer. The Pacific Coast is mild throughout the year, and the Atlantic Coast is mild in winter and hot in summer, the average July temperatures being similar to those of the interior. Winter rainfall is heavy on the Pacific, abundant over most of the Atlantic and St. Lawrence sections, and scant in the interior. Summer rainfall is more evenly distributed over the southern half of Canada. It is

more abundant in the east and far west than in the interior, where semi-arid conditions prevail in southern Alberta, Saskatchewan and parts of the Pacific region.

**Plant Life.** Canada's native plant life is one of its greatest assets. Its distribution illustrates an interesting adjustment to geographic environment, particularly to varying precipitation, temperature and soil. Since nearly all of Canada was covered by ice during the glacial epoch, the plant life that flourished before that time migrated southward, or northward into the unglaciated portions of Alaska, though some species were probably destroyed. As the ice receded northward vegetation followed the ice front; hence the present native plant life is composed almost entirely of post-glacial immigrants which established themselves in provinces or zones in which the climate and soil met their special requirements. In that portion of the Arctic, the treeless region, the vegetation is low-growing or dwarfed, with the woody types often prostrate or trailing on the ground. The southern boundary of this district extends far south of the Arctic Circle, along a line extending roughly from the mouth of the Mackenzie River around the south shore of Hudson Bay. From here it extends to the eastern shore of Ungava Bay and southeast to Hamilton Inlet in Labrador. Willows and dwarf birches are the most prominent woody forms of the region. Grasses, mosses and flowers in profusion cover large areas during the short growing season, constituting a true arctic prairie. From the shores of the Arctic Ocean southward to the forests more than 760 varieties of flowering plants, 330 varieties of mosses and 28 of lichens—all native—are known to thrive upon the surface, and in many places the flowers, mosses and lichens are completely obscured by the growth of grass, sedges and the like.

The southern limit of white and red pine extends southward and eastward from where the Arctic Circle crosses the Alaskan boundary, along the foothills of the Rocky Mountains, the northern border of the prairies to the southern end of Lake Winnipeg, and across the Gaspé peninsula to southern Labrador. This area is dominantly a coniferous forest region with a striking uniformity in species and general character. The trees are relatively small in size, and there are comparatively few species; black and white spruce, Banasian pine, birch, larch, balsam fir and poplar are found. The forest area which lies east of the southern end of Lake Winnipeg is characterized by deciduous trees, the principal ones being yellow birch, basswood, sugar maple, red maple, ash, elm, red and burr oak, hickory and beech. The abundant moisture and fairly long growing season provide for a luxuriant growth of plant life. In the grassland areas of Alberta, Saskatchewan and Manitoba the vegetation cover varies with the rain and snow supply, being more luxuriant in the east and varying to the semi-arid types in the west, where in the foothills it mingles with the Alpine types of the Rockies. Along the streams of the prairie there are a few



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**Forests.** There are three distinct forest areas in the Dominion. Eastern Canada is the source of most of the hardwoods produced, and although there is an absence of the highly prized hardwoods, maple, birch and beech abound. In the wooded districts of the prairie provinces, softwoods, of which spruces are the most abundant, are most generally found. The forests of British Columbia consist almost entirely of softwoods, the most valuable species being the Douglas fir. A few hardwoods occur, but they are of little economic importance.

Almost the whole of the forest areas of Canada are located on Crown lands and subjected to regulative control. About one-tenth of the forest land is alienated in fee-simple; slightly more than one-eighth is under lease or license to operators, and the remainder is held outright by the Crown. This State control and ownership of the forest areas is important in the administration of timber stands for sustained yields. There is little danger that present exploitation will decrease the potentialities of the forest growth. The natural average increase of timber will more than cover all present depletion. Should the cut of timber be greatly increased, reafforestation and greater efficiency in conservation would offset any decrease of resources. The Dominion government administers the forests in the provinces of Manitoba, Saskatchewan and Alberta, in the railway belt and Peace River block of British Columbia, and in the Yukon and Northwest territories. The forests of British Columbia, Ontario, Quebec, New Brunswick and Nova Scotia are administered by the provincial governments concerned.

The Dominion Forest Reserves and Parks Acts permanently dedicate certain defined areas known as Dominion Forest Reserves for the maintenance, production and reproduction of timber. These areas comprise 34,170 sq. mi. An additional 11,674 sq. mi. have been permanently dedicated as Dominion parks to be maintained and made use of as public parks and pleasure grounds for the benefit, advantage and enjoyment of the people of Canada. These lands are under the control of the Commissioner of Canadian National Parks; they are maintained in their natural state and commercial exploitation of them is prohibited.

**Lumber Industry.** Early lumbering centered round Quebec, receiving its first impetus from a de-

mand for spars and masts intended for the French navy. When the sawn lumber trade developed, Montreal became the center of the industry. Pioneer methods of lumbering were primitive in the extreme. Trees were felled and squared by hand in the woods, hauled by oxen or horses to a stream, assembled in rafts and floated down to Quebec. Today, logging trains haul the logs direct from the stand to the mills; in some cases the logs are hauled by cable systems. The caterpillar tractor transport is coming rapidly into wider use. Extensive operations employing large-scale methods, and also the depletion of saw-mill material in the east, diverted the bulk of the trade to British Columbia, where over 70% of the saw-timber supplies are situated.

**Pulp and Paper Industries.** The decline in eastern lumbering was offset by a rapid development in a pulp and paper industry which today ranks as the most important of the Canadian manufacturing industries. The first Canadian paper mill was erected in 1803, and for many years paper was manufactured chiefly from rags. When the supply of raw material showed signs of becoming exhausted, the paper makers were forced to experiment with straw, peat, fibers of plants, and so forth, but with little success. At length spruce and balsam were found to be suitable for the manufacture of average grades of paper. A new industry had been created, for while the older paper makers prepared their own fibers, mills came into existence to supply the pulp needs of newer paper mills. The first wood pulp mill began operations at Windsor Mills, Que., in 1870. Today there are three types of mills: those solely making pulp, those making pulp and paper, and those making paper only. Of the total paper production, 81% is newsprint and similar grades; paper boards 8%; wrapping papers 5%; book and writing papers 4%; and 2% miscellaneous papers. Canada is now the largest producer of newsprint in the world. In 1912 the value of exported newsprint alone amounted to \$4,000,000, and in 1928, \$118,000,000. The total export value of wood pulp and paper in 1930 amounted to about \$196,000,000.

**Animal Life.** There are three species of deer in Canada: the red or "white-tailed" deer, sometimes known as the Virginia deer; the "mule" or Rocky Mountain deer; and the "black-tailed" of the Pacific Coast. The three species are quite distinct. Reindeer lately introduced into the northern territories, are heavily built and short-legged; both male and female carry antlers. Wild reindeer are known as caribou. Herds of elk, the most graceful animal of western Canada, have been greatly reduced by hunters. There are less than 25,000 elk living today, and most of these are to be found in the immense animal sanctuaries of the national parks. "Moose nose" was a great delicacy to the Indians of past days. On account of its magnificent antlers, the moose has been much sought as one of the finest big-game animals. To the cavicorn group belongs one of the most trustful and affectionate of Canadian wild ani-



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The southern limit of white and red pine extends southward and eastward from where the Arctic Circle crosses the Alaskan boundary, along the foothills of the Rocky Mountains, the northern border of the prairies to the southern end of Lake Winnipeg, and across the Gaspé peninsula to southern Labrador. This area is dominantly a coniferous forest region with a striking uniformity in species and general character. The trees are relatively small in size, and there are comparatively few species; black and white spruce, Banasian pine, birch, larch, balsam fir and poplar are found. The forest area which lies east of the southern end of Lake Winnipeg is characterized by deciduous trees, the principal ones being yellow birch, basswood, sugar maple, red maple, ash, elm, red and burr oak, hickory and beech. The abundant moisture and fairly long growing season provide for a luxuriant growth of plant life. In the grassland areas of Alberta, Saskatchewan and Manitoba the vegetation cover varies with the rain and snow supply, being more luxuriant in the east and varying to the semi-arid types in the west, where in the foothills it mingles with the Alpine types of the Rockies. Along the streams of the prairie there are a few

trees. In the region between the Rockies and the coast mountains there is considerable variation in the native plant life. The principal trees are the lodgepole and white-bark pine, white spruce, balsam, fir and larch. Above the tree line there are many species of herbaceous vegetation, including many brightly colored flowers. In many undisturbed sections of this western region, fallen trees, shrubs, ferns and other herbaceous plants form almost a jungle. Along the coast, grass grows luxuriantly; the principal trees are Douglas fir, which attains great height, spruce, cedar, alder, hemlock and maple. The Douglas fir disappears above 50° N. lat.

**Forests.** There are three distinct forest areas in the Dominion. Eastern Canada is the source of most of the hardwoods produced, and although there is an absence of the highly prized hardwoods, maple, birch and beech abound. In the wooded districts of the prairie provinces, softwoods, of which spruces are the most abundant, are most generally found. The forests of British Columbia consist almost entirely of softwoods, the most valuable species being the Douglas fir. A few hardwoods occur, but they are of little economic importance.

Almost the whole of the forest areas of Canada are located on Crown lands and subjected to regulative control. About one-tenth of the forest land is alienated in fee-simple; slightly more than one-eighth is under lease or license to operators, and the remainder is held outright by the Crown. This State control and ownership of the forest areas is important in the administration of timber stands for sustained yields. There is little danger that present exploitation will decrease the potentialities of the forest growth. The natural average increase of timber will more than cover all present depletion. Should the cut of timber be greatly increased, reafforestation and greater efficiency in conservation would offset any decrease of resources. The Dominion government administers the forests in the provinces of Manitoba, Saskatchewan and Alberta, in the railway belt and Peace River block of British Columbia, and in the Yukon and Northwest territories. The forests of British Columbia, Ontario, Quebec, New Brunswick and Nova Scotia are administered by the provincial governments concerned.

The Dominion Forest Reserves and Parks Acts permanently dedicate certain defined areas known as Dominion Forest Reserves for the maintenance, production and reproduction of timber. These areas comprise 34,170 sq. mi. An additional 11,674 sq. mi. have been permanently dedicated as Dominion parks to be maintained and made use of as public parks and pleasure grounds for the benefit, advantage and enjoyment of the people of Canada. These lands are under the control of the Commissioner of Canadian National Parks; they are maintained in their natural state and commercial exploitation of them is prohibited.

**Lumber Industry.** Early lumbering centered round Quebec, receiving its first impetus from a de-

mand for spars and masts intended for the French navy. When the sawn lumber trade developed, Montreal became the center of the industry. Pioneer methods of lumbering were primitive in the extreme. Trees were felled and squared by hand in the woods, hauled by oxen or horses to a stream, assembled in rafts and floated down to Quebec. Today, logging trains haul the logs direct from the stand to the mills; in some cases the logs are hauled by cable systems. The caterpillar tractor transport is coming rapidly into wider use. Extensive operations employing large-scale methods, and also the depletion of saw-mill material in the east, diverted the bulk of the trade to British Columbia, where over 70% of the saw-timber supplies are situated.

**Pulp and Paper Industries.** The decline in eastern lumbering was offset by a rapid development in a pulp and paper industry which today ranks as the most important of the Canadian manufacturing industries. The first Canadian paper mill was erected in 1803, and for many years paper was manufactured chiefly from rags. When the supply of raw material showed signs of becoming exhausted, the paper makers were forced to experiment with straw, peat, fibers of plants, and so forth, but with little success. At length spruce and balsam were found to be suitable for the manufacture of average grades of paper. A new industry had been created, for while the older paper makers prepared their own fibers, mills came into existence to supply the pulp needs of newer paper mills. The first wood pulp mill began operations at Windsor Mills, Que., in 1870. Today there are three types of mills: those solely making pulp, those making pulp and paper, and those making paper only. Of the total paper production, 81% is newsprint and similar grades; paper boards 8%; wrapping papers 5%; book and writing papers 4%; and 2% miscellaneous papers. Canada is now the largest producer of newsprint in the world. In 1912 the value of exported newsprint alone amounted to \$4,000,000, and in 1928, \$118,000,000. The total export value of wood pulp and paper in 1930 amounted to about \$196,000,000.

**Animal Life.** There are three species of deer in Canada: the red or "white-tailed" deer, sometimes known as the Virginia deer; the "mule" or Rocky Mountain deer; and the "black-tailed" of the Pacific Coast. The three species are quite distinct. Reindeer lately introduced into the northern territories, are heavily built and short-legged; both male and female carry antlers. Wild reindeer are known as caribou. Herds of elk, the most graceful animal of western Canada, have been greatly reduced by hunters. There are less than 25,000 elk living today, and most of these are to be found in the immense animal sanctuaries of the national parks. "Moose nose" was a great delicacy to the Indians of past days. On account of its magnificent antlers, the moose has been much sought as one of the finest big-game animals. To the cavicorn group belongs one of the most trustful and affectionate of Canadian wild ani-

mals, the antelope. To the early settlers, the antelope was second only to the buffalo. At one time near extinction, this animal has been cared for in the national parks, and may yet become of commercial importance. Bighorn, or Rocky Mountain sheep, and goats roam the Rockies. The buffalo or bison, is now confined to the great parks of Alberta.

Native animal life is abundant both in the land and seas of the northern part of Canada. Seal, walrus, whale, fish, caribou, wolf, bear, fox, rabbit, ducks, geese, loon and mosquitoes are found. The hordes of mosquitoes are probably the greatest single handicap to the future use of this region's resources. Caribou roam over the land, from the Arctic islands far to the south, sometimes in herds numbering thousands. It is one of the principal animals of economic interest to the natives. The grass-eating muskox, or ovibos, is only of slightly less importance. It yields 10 to 15 lbs. of wool and its milk is of good quality.

**Animal Industry.** This industry is highly developed, and is linked with agricultural rather than with purely pastoral pursuits. It owes its importance to the expansion of dairying more than to the raising of livestock. The principal stock raised on the farms are cattle, hogs, sheep and poultry. The quantity of horses has been greatly increased owing to the numbers required on the western farms. The total number of livestock is small when compared with the number in the United States, but compares favorably with any one of several states.

Within her borders, Canada has one of the greatest fur-producing areas of the world, despite 300 years of exploitation. To safeguard this possession, each of the provincial governments makes its own regulations for the protection of the fur-bearers. Of the 3,494 Canadian fur farms in 1929, 3,067 were fox farms, 107 muskrat, 163 mink, 111 raccoon, 9 marten, 3 skunk, 5 fisher, 15 chinchilla rabbit, 2 caracul sheep and 10 beaver.

**Agriculture.** Agriculture is one of the main pillars of economic Canada. While providing employment directly and indirectly to more persons than any other class of occupation, it supports large rural districts which act both as consuming markets for finished goods and as reservoirs of raw materials for other industries. There are in the Dominion about 350,000,000 acres of land suitable for farming or grazing. This acreage is small when compared with the total land area, but it is an area which few other countries can rival. It is greater than the combined acreages of the British Isles, France, Denmark and Italy. The farmlands cover distinct and separate agricultural areas from the Atlantic to the Pacific, and thus enjoy a great diversity of climate, soil and contour. The greatest single region of farm land is the Prairie Provinces which contain slightly more than half the total crop land of the Dominion. About 30% of the total crop land is found in Quebec and Ontario combined, while British Columbia, with its enormous mountain territory, and the Maritime Provinces, form units small in extent, but which

support highly specialized farming communities. Of the total area of crop land, about 140,000,000 acres are under cultivation in field crops, orchards, etc. Many added millions of persons could be sustained on the remaining acreage. Although the western provinces produce the greater bulk of cereals in point of value of farm output, Quebec, Ontario and the Maritime Provinces, with their greatly diversified agriculture and highly developed dairy industries, contribute the greater share of Canada's total farm revenue. The value of the field crops raised annually is far in excess of the sum total of all other farm revenues combined; dairy products and live stock are next in order of value, but greatly behind the field crops. Wheat is the preeminent field crop in Canada. The western wheat crop of 56,000,000 bu. in 1900 rose to 544,000,000 in 1928. This growth practically built the whole business structure of the Prairie Provinces, and influenced the economic development of the entire Dominion. The bulk of the wheat supply is grown in the west. Oats, which are surpassed in importance only by wheat, are the support of the mixed farming, dairying and live stock industries of the east. Barley, corn, flax seed, buckwheat, rye, peas and beans, in the aggregate, yield a

#### PRINCIPAL FIELD CROPS, CANADA

1930 and Five-Year Average 1925-1929

Crop	Area	Yield	Total	Total
	acres	Per Acre	Yield	Value
		bu.	bu.	\$
Wheat .... 1930	24,897,900	16.0	397,872,000	174,792,000
Av. .. 1925-29	23,103,947	18.6	430,704,340	435,739,640
Oats ..... 1930	13,258,700	31.9	423,148,000	102,919,000
Av. .. 1925-29	12,830,594	30.6	392,083,200	191,224,120
Barley .... 1930	5,558,700	24.3	135,160,200	27,254,000
Av. .. 1925-29	4,296,678	24.3	104,549,620	59,776,620
Rye ..... 1930	1,448,050	15.2	22,018,500	4,401,500
Av. .. 1925-29	794,316	16.3	12,937,240	10,361,980
Peas ..... 1930	129,410	18.3	2,370,600	3,487,000
Av. .. 1925-29	151,695	17.7	2,681,740	4,810,020
Beans ..... 1930	98,680	14.6	1,438,600	3,261,400
Av. .. 1925-29	75,281	16.9	1,271,860	3,689,780
Buckwheat . 1930	490,300	22.2	10,903,300	7,124,000
Av. .. 1925-29	484,302	21.8	10,537,500	9,456,920
Mixed grains 1930	1,201,400	36.9	44,276,000	18,435,000
Av. .. 1925-29	1,009,230	35.6	35,897,240	25,143,380
Flaxseed .. 1930	581,800	7.6	4,399,000	4,194,000
Av. .. 1925-29	563,443	8.1	4,558,240	7,889,500
Corn ..... 1930	161,400	36.1	5,826,000	5,054,000
Av. .. 1925-29	174,273	37.9	6,612,660	6,651,940
Potatoes ... 1930	571,300	cwt.		
Av. .. 1925-29	552,127	84.4	48,241,000	39,858,000
Turnips ... 1930	225,930	81.0	44,747,380	62,130,180
Av. .. 1925-29	200,434	181.8	41,064,000	18,180,000
Hay and clover .. 1930	10,618,200	187.2	37,519,800	19,541,680
Av. .. 1925-29	10,037,392	tons		
Grain hay .. 1930	1,798,000	1.54	16,397,000	161,122,000
Av. .. 1925-29	1,645,451	1.57	15,747,640	172,389,480
Alfalfa .... 1930	744,000	1.76	3,159,000	21,254,000
Av. .. 1925-29	807,249	2.34	3,842,800	38,875,400
Fodder corn 1930	426,400	2.20	1,640,000	19,877,000
Av. .. 1925-29	473,018	2.39	1,929,040	23,960,160
Sugar beets 1930	52,500	8.15	3,475,700	17,142,000
Av. .. 1925-29	45,853	8.34	3,943,540	17,831,020
		8.97	471,000	3,238,000
		9.47	434,240	2,969,380

considerable revenue. In value, hay and clover are very important and head the list of field crops in every one of the five eastern provinces. Root crops are produced extensively, and sugar beet, tobacco and vegetables for canning have attained economic importance.

**Fisheries.** Fishing was the first industry to be followed systematically by Europeans in what is now the Canadian domain. The French, Spanish and Portuguese were there before 1502, plying their trade in the primitive manner of the time. To-day the industry is conducted on a large commercial scale on the Atlantic and Pacific coasts and on inland waters. Canada has about four-fifths of the North American fishing grounds within economic reach. Cod, haddock and other fish are caught on the offshore banks, while the inshore banks are stocked with abundant supplies of mackerel, herring, salmon, lobster, oysters, etc. The inshore fisheries of the Atlantic employ ten times more men than the deep-sea fisheries. Motor boats have extended the field of the inshore fishermen, many of whom farm as well as fish. Now they can reach the outlying fisheries, make their haul and return speedily to the shore. There are widely differing deep-sea and inshore fisheries off the coast of British Columbia, the most valuable fish being the salmon, which has given rise to a great canning industry. Halibut, herring, flatfish, pilchards and cod are also caught. All the inland fisheries, Great Lakes, Hudson Bay, Lake Winnipeg, etc., are readily accessible. The main varieties are whitefish, sturgeon, pike, pickerel, trout and herring. The fisheries of Canada are very important so far as capital and labor are concerned. Over 62,700 workers are employed in the catching of fish, and the value of vessels, nets, traps, piers, etc., is about \$35,000,000. Fish canning and curing gives employment to about 10,000 men and 5,500 women, the capital invested in these activities amounting to \$27,000,000.

**Minerals.** The mineral resources of Canada are varied and extensive. In Ontario, the Porcupine Camp is the second largest gold-producer in the world. Kirkland Lake Camp has a large and rapidly increasing production. The Rouyn district, in north-west Quebec, is only a recent discovery, but huge quantities of copper, gold and zinc ore have already been extracted. The bulk of the world's nickel supply is obtained in the Sudbury district of Ontario. Silver is mined at Cobalt, Gowganda and South Lorrain, Ont. Extensive deposits of iron-ore are located north of Lake Superior and on the Belcher Islands of Hudson Bay. Vast deposits of copper-zinc are being developed at mines in northern Manitoba. Eastern Canada contains a wide variety of minerals of which coal is the most important. Bituminous coal has been exploited for more than 200 years, but it is estimated that over 2,180,000,000 metric tons of good steam and coking coal remain. Alberta produces much lignitic coal. In the Quebec district are the asbestos mines which produce 70% of the world's supply. Crude petroleum occurs in

many places of the Prairie Provinces, notably in Turner Valley, Alberta.

#### MINERAL PRODUCTION, CANADA, 1929

<i>Product</i>	<i>Quantity</i>	<i>Value</i>
<b>METALLIC:</b>		
Bismuth .....lb.	194,329	\$ 307,114
Cadmium ..... "	773,976	675,294
Cobalt ..... "	929,415	1,801,915
Copper ..... "	248,120,760	43,415,251
Gold .....oz.	1,928,308	39,861,663
Lead .....lb.	326,522,566	16,544,248
Nickel ..... "	110,275,912	27,115,461
Platinum .....oz.	12,519	846,756
Silver ..... "	23,143,261	12,264,308
Zinc ..... lb.	197,267,087	10,626,778
Other metals .....		995,268
Total metallic minerals...		154,454,056
<b>NON-METALLIC:</b>		
<i>Fuels</i>		
Coal .....tons	17,496,557	63,065,170
Natural gas ....M cu. ft.	28,378,462	9,977,124
Petroleum, crude....bbls.	1,117,368	3,731,764
<i>Others Items</i>		
Asbestos .....tons	306,055	13,172,581
Feldspar ..... "	37,527	340,471
Fluorspar ..... "	17,870	268,120
Gypsum ..... "	1,211,689	3,345,696
Magnesite ..... "	18,809	491,170
Mica ..... "	4,053	118,549
Quartz ..... "	265,949	561,527
Salt ..... "	330,264	1,578,086
Sulphur ..... "	42,781	350,843
Talc ..... "	15,509	181,212
Miscellaneous .....		679,043
Total Non-Metallic Minerals		97,861,356
<b>CLAY PRODUCTS AND OTHER STRUCTURAL MATERIALS:</b>		
Brick, Tile, etc. ....		13,904,643
Cement .....bbls.	12,284,081	19,337,235
Lime .....tons	674,087	5,908,610
Sand and gravel .... "	27,846,945	7,317,814
Stone ..... "	9,622,424	12,066,532
Total Clay Products and Other Structural Materials.		58,534,834
<b>GRAND TOTAL</b> .....		<b>310,850,246</b>

**Water Power.** Hundreds of millions of dollars have been invested in water power development during recent years, and in 1928 alone, new plants with a total output of 550,000 horse-power were installed. The new plants have an estimated total output of 2,000,000 h.p., bringing the Dominion output to over 7,000,000 h.p. Among the world's leading countries using water power, Canada now ranks second to the United States.

**Communication.** In the days of the pioneer, the waterways afforded almost the only route of travel, and such obstacles as rapids and waterfalls had to be overcome by canal systems. There are now six such systems controlled by the Dominion government: Montreal to Ottawa; Montreal to Fort William; Montreal to the international boundary near Lake Champlain; Ottawa to Kingston; Trenton, Lake Ottawa, to Lake Huron; Atlantic Ocean to the Bras d'Or Lakes in Cape Breton Island. The total length of the waterways comprising these systems is about

1,594 mi., the actual mileage of the canals constructed being 117.2. By overcoming the problems of navigation, so far as the rapids and waterfalls are concerned, the canal systems have made the St. Lawrence and the Great Lakes famous as the finest internal navigation system in the world. Ocean vessels are navigated 1,000 mi. inland to Montreal, and certain lake vessels may proceed to Port Arthur, another 1,000 mi. farther west. The total tonnage of freight conveyed on Canadian canals exceeds 20,000,000 yearly.

The most important event in the annals of Canadian railroad building was the linking of the Pacific with the Atlantic when the Canadian Pacific Railway was completed in 1885. In 1915 a second transcontinental line, the Grand Trunk Pacific, had been laid from coast to coast, but the World War shattered the hope of success for the new railroad. The Grand Trunk, Grand Trunk Pacific and the Canadian Northern railways passed under government control in 1922; the Intercolonial and several branch lines in Quebec, Nova Scotia and New Brunswick were added to the system, now known as the Canadian National Railways.

There are over 285,000 mi. of Canadian telegraph wires controlled by the government, the Canadian Pacific Railway and the Canadian National Telegraph Co. Comparatively few households are without a telephone, there being over 1,000,000 telephones, with 3,000,000 mi. of wire, in use.

**Manufactures.** The primary needs of the early settlers were food and shelter, so the land was cleared for agriculture, and the wood removed used for housing and fuel. Under the French regime, flour-milling was the first industry. During the Napoleonic wars, heavy and insistent demand for wheat and flour more than quadrupled the export of Canadian

flour, and since those days the industry has developed greatly. The next immediate need of the settlers was that of clothing. Vessels from Europe called infrequently at Canadian ports with cargoes of clothes, and the settlers were compelled to manufacture their own supplies of crude footwear. The first cotton factory was not erected until 1844. With the introduction of steam-driven machinery, manufacturing became established in cotton centers near economic resources where adequate supplies of labor might be drawn upon. The demand for machinery increased the demand for iron and coal. On the whole, mainly owing to the lack of economic unity throughout the land, the various industries progressed slowly. With increased population caused by the opening up of western Canada, industrial activity greatly increased. The settlement of the prairies gave rise to industries supplying an abundance of raw materials for flour mills, meat-packing plants, tanneries, butter and cheese factories and the like. At the same time it created an extensive new market for plants in eastern Canada manufacturing farm and other machinery, elevators, textiles, rubber, leather and furniture. The advance in production was assisted by the prodigal resources of water-power and hydroelectricity. The major portion of the manufacturing industries are located in Ontario and Quebec. These provinces include about 60% of the total population of the dominion, and about 80% of those employed in manufacturing.

Vegetable, animal, wood and paper products figure largely in the total value of manufactured output, the raw materials being drawn mainly from agriculture, lumbering, ranching and fishing. Iron and steel, textile, rubber and refining industries depend heavily upon imported raw materials. Food products occupy a high place in the manufactured out-

#### LEADING PRODUCTIONS OF CANADA

Giving Value and Rank by Provinces, 1929

Province	Field Crops	Farm Live Stock	Dairy Products	Fisheries	Mineral Products	Lumber	Total Manufactures
Alberta .....	\$ 157,254,000	123,133,000	18,928,425	732,214	34,739,986	2,852,440	107,556,792
Rank	3	4	4	8	4	6	5
British Columbia .....	\$ 20,398,000	32,364,000	9,678,232	23,930,692	68,162,878	64,637,301	276,950,914*
Rank	8	6	7	1	2	1	3
Manitoba .....	\$ 78,919,000	66,472,000	14,404,066	2,745,205	5,423,825	2,095,613	164,909,127
Rank	5	5	5	6	6	7	4
New Brunswick .....	\$ 23,835,000	17,975,000	8,733,635	5,935,635	2,439,072	12,164,604	71,433,966
Rank	6	8	8	3	8	4	8
Nova Scotia .....	\$ 20,945,000	22,076,000	11,463,561	11,427,491	30,904,453	3,205,217	94,292,816
Rank	7	7	6	2	5	5	6
Ontario .....	\$ 241,778,000	277,720,000	115,757,270	3,919,144	117,662,505	32,743,346	2,103,090,788
Rank	1	1	1	4	1	2	1
Prince Edward Island .....	\$ 16,940,400	9,588,000	2,955,291	1,297,125	.....	139,929	4,638,725
Rank	9	9	9	7	.....	9	9
Quebec .....	\$ 153,664,000	172,452,000	86,697,614	2,933,339	46,358,285	28,342,626	1,160,612,992
Rank	4	2	2	5	3	3	2
Saskatchewan .....	\$ 235,248,000	134,950,000	23,124,763	572,871	2,253,506	808,488	80,501,159
Rank	2	3	3	9	9	8	7
Yukon .....	\$ .....	.....	.....	24,805	2,905,736	.....	.....
Rank	.....	.....	.....	10	7	.....	.....
Total .....	\$ 948,981,400	856,730,000	291,742,857	53,518,521	310,850,246	146,989,564	4,063,987,279

\* Including figure for Yukon.



put, giving rise to flour-milling, slaughtering and meat-packing. To these must be added dairy factories, sugar refineries, bakeries, plants engaged in the canning of fish, vegetables and fruit; with the exception of sugar refining, all these industries are based on the finishing of Canadian natural products. Forest products rival food products in value of output.

**Commerce.** The home produce that enters Canadian commerce is the product of its farms, forests, mines and seas. Canada is primarily a seller of raw and partly manufactured material and a buyer of manufactured articles. Vegetable, forest and live stock products are the three dominant classes of the export trade, constituting more than four-fifths of the total. The imports are more evenly divided among four classes, viz., agricultural and vegetable products, fibers and textiles, iron products, and non-metallic minerals, which make up three-fourths of the total. Most of these materials are not produced in sufficient amount at home, or are not produced in advantageous locations for general distribution throughout the Dominion.

The Maritime Provinces and British Columbia have excellent outlets. The Quebec and Ontario region, with three-fourths of the total commerce of the country, has splendid inland transportation. The commerce of the Prairie Provinces depends upon inland transportation with the principal markets in the United States; but the completion of the Hudson Bay route is an inestimable boon to this region. Grain shipped to Europe via Churchill takes a much shorter route than in the past. For example, grain routed from

Saskatoon via Winnipeg, Fort William, Port Colborne and Montreal to Liverpool, journeys 4,866 mi., with transshipments at Port Colborne and Montreal; via Warman, Melfort, Hudson Bay Junction and Churchill, the journey is reduced to 3,760 mi. and transshipments are avoided. Freight and passenger services are operated between Montreal and Halifax to Newfoundland in season; Halifax to the Bermudas and West Indies; Montreal-Halifax, via the Panama Canal, to Vancouver, B.C.; Vancouver to San Francisco; and Vancouver and Victoria to Skagway, Alaska. The chief ports for ocean traffic are Montreal, Halifax, St. John, Quebec and Vancouver. Other ports of growing importance are Prince Rupert, Churchill, Sorel, Three Rivers and Sydney, N.S.

**Defense.** The Royal Canadian Navy in 1931 consisted of four destroyers and four mine sweepers. The authorized complements are 104 officers and 792 men of the permanent force, 70 officers and 430 men of the reserve, and 70 officers and 930 men of the volunteer reserve. The strength of the Royal Canadian Air Force in 1930 was 177 officers and 681 airmen. The Royal Canadian Mounted Police had a strength in 1931 of 56 officers, 1,065 in other ranks, and 123 special constables. The Canadian Militia is classified as active and reserve. The permanent force consists of 11 units of all arms, with an authorized establishment limited to 10,000. The non-permanent militia totals 8,971 officers and 114,580 in other ranks, able-bodied citizens between the ages of 28 and 60 who go through annual training.

**Government.** Canada is a self-governing Dominion of the British Commonwealth of Nations. Like its British prototype, the Canadian constitution is unwritten; it is merely the British constitution federalized, all that has been committed to writing being a delimitation of the respective powers of the Dominion and Provincial governments, and an enactment of the terms of the Confederation Agreement. The executive power is vested in the sovereign of the United Kingdom, who is represented in the Dominion by a governor-general, and in the provinces by lieutenant-governors. In theory, the governor-general is at the head of the government, appoints the provincial lieutenant-governors, makes appointments to the government services, disallows provincial legislation, and is the supreme officer of the Canadian armed forces. In practice, he is expected to follow the long-established custom of performing such actions on the advice of his cabinet, of which the members accept all responsibility for his actions.

The legislature is composed of a Senate numbering 96 members and a House of Commons, numbering 245 members in 1930. The Senators are appointed for life by the Crown, acting through the governor-general. The House of Commons is chosen by almost universal male and female suffrage, and as in England is the chief branch of the government. Members are elected for the duration of Parliament, which may not last beyond five years, the province of Quebec always having 65 members, and the other prov-

#### CANADA, EXTERNAL TRADE

Fiscal Year, 1930-31

##### IMPORTS:

<b>Industria. Group</b>	
Agricultural and vegetable products .....	\$177,628,778
Animals and animal products .....	45,995,705
Fibers, textiles and textile products .....	130,717,022
Wood, wood products and paper .....	46,042,029
Iron and its products .....	194,888,443
Non-ferrous metals and their products .....	59,623,263
Non-metallic minerals and products .....	153,578,658
Chemicals and allied products .....	35,650,772
Miscellaneous commodities .....	62,488,011
Total imports .....	906,612,681
Total, Dutiable Imports .....	\$574,090,216
Total, Free Imports .....	332,522,465
Duty Collected .....	149,097,855

##### EXPORTS:

<b>Industrial Group</b>	
Agricultural and vegetable products .....	\$292,280,037
Animals and animal products .....	83,714,772
Fibers, textiles and textile products .....	6,504,182
Wood, wood products and paper .....	230,514,474
Iron and its products .....	38,937,661
Non-ferrous metals and their products .....	95,652,063
Non-metallic minerals and products .....	21,107,780
Chemicals and allied products .....	12,825,852
Miscellaneous commodities .....	18,115,846
Total, Domestic Exports .....	799,652,667
Total, Foreign Exports .....	17,285,381
Total, Exports .....	816,938,048
GRAND TOTAL, EXTERNAL TRADE .....	1,723,550,729

inces proportionally, according to their population at each decennial census. The procedure of Parliament at Ottawa has many points in common with the procedure at Westminster. With the exception of Quebec, the legislature of each province is a Legislative Assembly elected by the people. Quebec has a Legislative Council and a Legislative Assembly.

Judges in the provinces are appointed by the Dominion government. The Supreme Court of Canada has appellate jurisdiction from all courts of the provinces; it has jurisdiction in certain cases between the provinces and in cases of controversy between provinces and the Dominion. From the Supreme Court there may be an appeal to the judicial committee of the Privy Council.

**Finance and Banking.** The financial position of Canada showed vast improvement in 1930 over that of ten years previously. The gross debt which stood at \$3,041,539,587 on Mar. 31, 1920, stood at \$2,603,437,648 on Mar. 31, 1930, a reduction of \$425,673,690 in the period. The net debt of Canada on the latter date was \$2,177,763,958. The funded debt, which may be regarded as the safest index, was reported at \$2,250,837,336 on Mar. 31, 1930. The annual interest charges on the outstanding securities in the hands of the public for the 1930-31 fiscal year amounted to \$112,900,000. All this represents sound public finance and the strong recuperative power of the country. Taxation was being lightened, while the public revenues held strong, income taxes for 1929-30 yielding \$9,700,000 in excess of the previous year.

The banking system of the country has been carefully regulated by the government. The banks are few, but each has many branches; as few as 11 banks operate over 4,000 branches in Canada and Britain, and about 200 in foreign countries.

**Inhabitants.** The French were the first Europeans to effect a permanent settlement in the country. According to the census of 1665 the small nucleus who had followed the leadership of Samuel de Champlain had by that year expanded into a colony of 3,215. By the end of the 17th century the 15,000 mark had been passed, and by the year 1725 the population exceeded 50,000. At the conclusion of the war of conquest the Scottish Highland and other soldiers were disbanded, many of them settling down in Quebec. Inter-marriage with the French followed, and the new generation was instructed in the language and customs of an old-world France. By 1763, 70,000 persons were inhabiting New France, the French element predominating, and about 10,000 French mingled with a British population of the same extent in what are now termed the Maritime Provinces. Some 10,000 United Empire Loyalists entered Nova Scotia and New Brunswick at the conclusion of the War of American Independence. Others hastened to the St. Lawrence region, and before the close of 1789 the Loyalist stock of Ontario had increased to 30,000. The population at the opening of the 19th century was approximately 250,000. Census-taking was very

desultory, and not until 1851 did a regular decennial census commence. The present century has been a period of remarkable expansion, the outstanding feature being the opening of the west.

#### CANADA, GROWTH IN POPULATION

By Provinces 1871-1931

Province	1871	1901	1931
Alberta .....	.....	73,022	731,605
British Columbia .....	36,247	178,657	694,263
Manitoba .....	25,228	255,211	700,139
New Brunswick .....	285,594	331,120	408,219
Northwest Territories* .....	48,000	20,129	7,133
Nova Scotia .....	387,800	459,574	512,846
Ontario .....	1,620,851	2,182,947	3,431,683
Prince Edward Island .....	94,021	103,259	88,038
Quebec .....	1,191,516	1,648,898	2,874,255
Saskatchewan .....	.....	91,279	921,785
Yukon .....	.....	27,219	4,230
Total .....	3,689,257	5,371,315	10,374,196

\* The decrease in population is owing to the separation of large areas to form other territories and provinces.

The population is homogeneous to a remarkable extent, despite the diversity of basic ethnic stocks from which it is drawn. In 1871, 97.2% of the population were British born; within 50 years this percentage had shrunk to 87.9%. The Canadian-born element was 86.9% of the total in 1901, and 77.7% in 1921. Of the population in 1921, 55% was British stock, and slightly less than 28% was French, the two stocks thus forming 83%. The remainder was divided among 70 other stocks. More than seven-tenths of the French are in Quebec where they constitute four-fifths of the total population. The British are much more widely scattered, yet more than two-fifths are in Ontario where they compose a like proportion of the total population of that province. There are about 3,500 Eskimos and 110,000 Indians in the Dominion; they represent a little more than 1% of the total population. About 50,000 Indians are engaged in hunting and trapping in British Columbia and Ontario. English and French are the official languages. The French language is confined mainly to Quebec and sparingly in other provinces.

The area and population of the provinces and territories are as follows:

Provinces and Territories	Area in square miles	Population in 1921	Population in 1931
Prince Edward Island ..	2,184	88,615	88,038
Nova Scotia .....	21,428	523,837	512,846
New Brunswick .....	27,985	387,876	408,219
Quebec .....	594,434	2,360,665	2,874,255
Ontario .....	412,582	2,933,662	3,481,683
Manitoba .....	251,832	610,118	700,139
Saskatchewan .....	251,700	757,510	921,785
Alberta .....	255,285	588,454	731,605
British Columbia .....	355,855	524,582	694,263
Yukon .....	207,076	4,157	4,230
Northwest Territories:			
Franklin .....	554,032	7,988	7,133
Keewatin .....	228,160		
Mackenzie .....	527,490		
Total .....	3,690,043	8,787,464	10,374,196

H. A. A.

**CANADA, HISTORY OF.** The general account of Canadian history which follows is divided for ready reference into four major chronological divisions: I. The period of New France, ending with Great Britain's acquisition of title by conquest in 1763. II. The development of Canada first under the fundamental law of the Quebec Act, to 1791; then under the Canada Act, to 1841. III. The trial and failure of the fundamental law of the Union Act, 1841-67. IV. The progress of the Dominion of Canada from 1867-1932.

#### I. NEW FRANCE

**The Era of Chartered Monopolies.** JOHN CABOT, financed by English merchants, reached Canadian shores in 1497, and thereafter fishing boats from Europe frequented the Newfoundland banks. The expedition of JACQUES CARTIER in 1534, sponsored by Francis I, laid the foundations of French domain in North America; but after Roberval's (*see* ROBERVAL, SIEUR DE) abortive attempts at settlement, 1542-43, French interest in the New World lagged until monopolistic privileges in the Canadian fur trade passed to SIEUR DE MONTS, 1603. Under his leadership Port Royal (now Annapolis) was established in 1605, and three years later Quebec was founded by his agent, SAMUEL DE CHAMPLAIN. RECOLLET MISSIONS were established in Indian villages. Champlain, ETIENNE BRULE and JEAN NICOLET penetrated the wilderness. Intimate trade relations were established with the Hurons and Algonquins, while the IROQUOIS-FRENCH WARS were begun. But Quebec was still the only French post in Canada when in 1627 the COMPANY OF ONE HUNDRED ASSOCIATES was established. The new monopoly was interested in colonization, of Catholics only; Christianization of the Indians, and exploitation of the fur trade. The missionary zeal of the Church, as manifested in the Jesuit missions, made the second of these aims the most successful of the three. The trading privileges were transferred to an association of merchants in New France, *Compagnie des Habitans*; new villages appeared, Three Rivers in 1534, Sillery in 1637 and Montreal in 1642; and in 1647 a governing council was established, including the governor-general of New France, the Superior of the Jesuits, and the commandant of troops at Montreal. In 1648 two citizens, chosen by the other three members, were added to the council. Bickerings within the council after FRANÇOIS-XAVIER DE LAVAL arrived to rule the Church in Canada, and the slow rate of colonization—New France in 1663 contained only about 3,000 inhabitants, most of these priests, traders and officials—prompted Louis XIV to revoke the charter of the company.

**Canada as a Royal Province.** In the first decade of direct royal control, 1663-73, the population of New France more than doubled. JEAN BAPTISTE TALON, first of the intendants, was the most important of many officials placed in newly created offices. The Council of Quebec was increased in 1674, and met weekly to discuss large problems and adjudicate

the welter of petty disputes that came to the only governing board in the province. Pierre Radisson and Sieur de Groseilliers (*see* RADISSON AND GROSEILLIERS) had revived the fur trade and extended the range of exploration. La Salle (*see* LA SALLE, René Robert Cavelier) began his memorable series of explorations in 1669. Two Sulpicians, Francis de Casson and René de Galinee (*see* CASSON AND GALINEE), the Jesuit, JACQUES MARQUETTE, and the Recollet LOUIS HENNEPIN carried on the traditional combination of missionary enterprise and exploration. LOUIS JOLIET, SIEUR DU LHUT and HENRI TONTI were outstanding representatives of the hardy traders, intrepid and happy in the wilderness and fraternizing with the Indians. Frontenac (*see* FRONTENAC, LOUIS DE BUADE), governor of New France from 1672-82 and from 1689-98, brought unprecedented statesmanship to that executive position, managed Indian affairs skillfully, upheld the French fur trade against the English menace (*see* FRENCH AND INDIAN WARS), and began a projected series of fortifications along the Great Lakes and to the Mississippi.

Every detail of government and conduct was reserved to the Crown and administered by the King personally or by his agents in New France. Emigration was fostered, wives were recruited, supplies were donated by the monarchy; trade and industry were regulated meticulously. The one authority co-ordinate in any particular was the Church. No Huguenot was allowed in the colony. The Church was the greatest landowner in New France, tithing was fixed by law, and education was the monopoly of the clergy. In general the Church was a powerful factor in every phase of life. A *noblesse* was established from among military officers in the colony, members of the petty nobility in France who emigrated, and merchants able to pay for the honor. These *seigneurs* were endowed with forest tracts with a river frontage, and the tenants, or *censitaires*, were economically subject to their seigneurs. The seigneur owed fealty to the King's viceroy, and had no political power of his own. His lands were possessed not in freehold but in trust from the Crown, subject to the fulfillment of certain feudal obligations, military service in particular. The holdings of the *censitaires*, or habitants, averaged from 100 to 400 square arpents, the *corvée*, requiring three to six days' labor a year, and *banalités*, fees for the use of the mills, ovens, wine-presses and like paraphernalia of the seignior, were two of several obligations owed the landlord by the tenant. Feudalism was in fact vitalized in New France coincident with its decay in Western Europe.

In the years after Frontenac the defects of the paternalistic and feudalistic scheme of New France became apparent, inherently as well as by comparison with the English colonies. Three-fourths of the population lived on farms, thin parallelograms with a river frontage; the back country was neglected. Practically all of the cleared land, about 350,000 arpents in 1760, lay along the St. Lawrence between Montreal and Quebec. The habitant followed a frugal, pious life

of amiable contentedness, from which existence the conservatism and satisfied isolation of the French-Canadians is derivative. Social gayeties and luxury were centered at Quebec, where members of the official class headed the social order; these urban recreations were mimicked on a small scale at Montreal and Three Rivers. Outside the towns the seigneur and the curé divided importance. Industry made little progress even when the Government sporadically offered subsidies. Taxes, monopolies and rigid supervision, together with inflated, unstable currency, turned persons of commercial bent to illicit enterprises, and illegal trade with the Indians and English increased while legitimate exports remained at a low level and consisted almost entirely of raw material.

Ambitious habitants deserted their holdings and became *coureurs-de-bois*, following the fur trade in the wilderness despite the royal monopoly of that trade; many of these adventurers adopted Indian ways of living and acquired Indian wives. French traders and missionaries occupied the strategic points of access to the interior of the continent, and La Verendrye extended the range of exploration to the Rocky Mountains; the foothold obtained by Pierre le Moyne Iberville in the Lower Mississippi region was maintained by Bienville. The fur trade dominated the economic life of New France; control of the interior of the continent, necessary for the protection of the fur trade against similar English interests, was recognized by France in policy but was never made effective. Lead plates were inadequate substitutes for colonists. In 1756 the SEVEN YEARS' WAR began; in 1763 the French regime came formally to an end.

## II. CANADA A BRITISH COLONY

**The Transfer of Canada.** After the fall of Quebec and Montreal the British divided Canada into three military districts for temporary rule; Gen. Amherst acted as military governor of the entire territory. French folkways and laws were not disturbed; tact characterized this administration. The Treaty of Paris, 1763, allowed any one who might wish to return to France 18 months in which to dispose of his properties; only a few hundred, practically none of the clergy, chose to leave. The PROCLAMATION OF 1763 created the province of Quebec as the governmental unit for the French-Canadian population, estimated at from 65,000 to 70,000. A governor and appointive council were provided for; an elective assembly was promised when conditions warranted. A judicial system was to be established, governed by English law and equity "as near as may be agreeable." Upon William Pitt's declension, James Murray was named first civil governor. An excellent French scholar and sympathizer with French character, Murray attempted to avoid friction. But dissension among the habitants at the acts of poorly qualified judges appointed in England, and among the French agriculturists and the entrenched minority of English businessmen could not be avoided. In 1766 Murray

was succeeded by Sir Guy Carleton, later created Lord Dorchester. Carleton concluded that Canada was most likely to remain in the British Empire if liberal concessions were made to the French-Canadians, and exercised great influence in the drafting of the QUEBEC ACT OF 1774.

**Canada under the Quebec Act.** The inhabitants were granted "free exercise of Religion of the Church of Rome, subject to the King's Supremacy." They were exempted, however, from the Oath of Supremacy, and only a pledge of allegiance to the King, and a promise to report treasonable conspiracies, were required. A governor and appointive council were to make the ordinances necessary to government, subject to certain reservations by the Crown; the French population as yet demanded no measure of autonomy. The act retained for England the loyalty and support of the seigneurs and the Catholic clergy, the two most influential classes. It embodied liberal concessions with a view to preventing the spread of the disaffection in the 13 colonies into Canada. In perpetuating the antiquated French civil law, however, it hampered the business interests of the English element. With the outbreak of the REVOLUTIONARY WAR, the immediate importance of military defense took precedence over the establishment of civil government. The assumption of the American Revolutionists that the French-Canadians were chafing under British rule proved groundless. Ethan Allen was dispatched by the Continental Congress to make personal appeals to the habitants; open letters and addresses from leading Revolutionists were circulated, and an American invasion of Canada was undertaken upon the promise that a successful assault on the two British strongholds, Quebec and Montreal, would induce the Canadians to join in the war against England. The task of upholding British interests against the flood of propaganda and the military invasion fell to Gov. Carleton, who, despite the fact that his force of regulars did not exceed 1,000, met the emergency. (See MONTREAL, BATTLE OF; QUEBEC, BATTLE OF.) Several hundred Canadians joined the American army and retired with it; they were eventually given lands in Ohio by the United States Congress. The Quebec Act served to assure the loyalty of the great bulk of the Canadian population; and British armies in 1777 safely used Canada as a base of operations. Long before the close of the Revolution migrations of LOYALISTS began; by 1795 the Loyalist stock of the region west of Montreal, the future Upper Canada, was estimated at 30,000, and that of Nova Scotia and New Brunswick, whose foundations, in a sense, were laid by the Loyalist invasion, at from 35,000 to 40,000. The British Government spent at least \$30,000,000 to settle and adjust this new population. New Brunswick and Nova Scotia, dominated by the Loyalists, at once expressed a liberalizing of political institutions. In the two major provinces the Loyalist invasion determined that Canada should develop as an English province, and overruled the tendencies of the Quebec

Act; but in its forecast of the changed destiny of Canada it induced the French element to cohere in opposition. The Quebec Act was obsolescent with the accession of English stock from the Atlantic seaboard, and the CANADA CONSTITUTIONAL ACT OF 1791 established a new government.

**Lower Canada.** The 10,000 English in Lower Canada were outnumbered one to 15; but this minority could expect the support of the governor and legislative council, all office-holders by appointment, whose consent was necessary to legislation. During Lord Dorchester's tenure as governor-general, 1791-96, international relations dominated the political field; but the forthcoming internal conflict was apparent in the discussion of revenue measures. The French element, primarily agricultural, advocated a duty on imports; the English, representing the mercantile interests of Quebec and Montreal, preferred a land tax. Gen. Robert Prescott, governor from 1796-99, became involved in controversy with land speculators who had influence in his council; Robert Shore Milnes, 1799-1807, was equally unhappy. Under the governorship of Sir James Craig, 1807-11, racial antipathies became highly important. Craig, a martinet, suppressed *Le Canadien*, an organ of French national spirit; in 1809 he dissolved the assembly as a rebuke to the French party. The newly elected assembly was more obstreperous than its predecessor; promptly it began a contest for control of financial legislation and the right to bar judges from its membership. To Sir George Prevost, 1811-15, fell the responsibilities of governor during war-time. Prevost and Sir John Coape Sherbrooke, 1816-18, vainly attempted to alleviate racial antagonisms, distributing patronage carefully and showing favor to the Roman Catholic hierarchy in Canada. The popular party, however, was intransigent, and harried those Tories who simultaneously held posts on the King's Bench and the assembly by preferring impeachment charges against some of them. In 1818 the British Government accepted the proposal of the assembly to rely entirely on the colonial revenues for the normal expenditures of the province; thereby the assembly prevented the diversion of the revenues for ends concerning which it was not consulted. The assembly attempted to press its advantage by claiming control of all expenditures of the provincial administration. The quarrel over supply bills became turbulent during the governorship of the Duke of Richmond, 1818-20. Lord Dalhousie, his successor, strove vainly with an obdurate assembly to secure a permanent civil list.

**Upper Canada.** In practice the Constitutional Act was so modified that the lieutenant-governor of Lower Canada did not function, his duties falling to the governor, and the lieutenant-governor of Upper Canada became the highest executive officer in the province. Col. John Graves Simcoe, first executive in the Loyalist province of Upper Canada (English population, 20,000; French, insignificant), showed rare ability in civic enterprise, laid the foundations

of local government, and encouraged emigration from the United States. During the tenure of Francis Gore, which began in 1806, party politics definitely appeared: a clique of Loyalists which began to monopolize control of the executive and legislative councils; and a party, making headway in the elective assembly, of liberalizing tendencies. The steady influx of settlers from the United States and Scotland strengthened the opposition to the FAMILY COMPACT. During the WAR OF 1812 Sir Isaac Brock was lieutenant-governor of Upper Canada.

**Relations with the United States.** Antagonism between the United States and British North America mounted steadily toward the crisis of 1812. The States did not enact legislation to compensate the dispossessed Loyalists, as the Treaty of 1783 had recommended; the British, profiting by the fur trade below the Great Lakes, failed to evacuate their military posts in the Old Northwest. American pioneers in the Ohio valley attributed their troubles with the Indians to British intrigue; at Malden, indeed, British officials regularly met and fêted Indians from American domain. An unwise address of Lord Dorchester, while Gen. Anthony Wayne was campaigning against the Indians in Ohio settlements, invoked a formal protest from the United States and led to Dorchester's resignation. Edmund Genet (*see* GENET'S MISSION) sent agents into Canada to enlist the French-Canadians in the support of French Republicanism and in opposition to British rule in Canada. While French revolutionary propaganda collapsed against the immovable obstacle of the Roman Catholic clergy, loose talk of a French invasion of Quebec with the aid of Republicans from the United States created anxiety. The unrestrained self-satisfaction of American democracy found an irritated audience in Canada. On the other hand, Americans could not accept the attachment of Canadians to the Crown without making insulting inferences as to the character of Canadians.

When the War of 1812 began, circulation of such remarks as Jefferson's "The Acquisition of Canada is a mere matter of marching" had put the English element in Canada into a fighting temper; but in every respect Canadian resources were greatly inferior to those of the United States. There were at the outbreak of war, 4,450 British regulars along the Canadian frontier, and 4,000 Canadian regulars, at most, available. Canadian militia and Indian allies supplemented these forces as the war progressed. Trade relations between New England and the Maritime Provinces were little interrupted, and Nova Scotian shipowners fared well with the profits of privateering. Along the New York border and the Great Lakes the defense of Canada, unexpectedly successful, created confidence and assurance that did much toward knitting United Canada into an entity.

After the war the Loyalist influence in Canadian politics became more pronounced, with increased acceptance of their creed, hostility to the United States and its institutions. Reactionaries were enabled to



dominate provincial government because of the extensive distrust of democracy. Boundary disputes (*see* CONVENTION OF 1818; AROOSTOOK WAR) and controversies over commercial rights (*see, e.g.,* NORTH ATLANTIC FISHERIES DISPUTE) fanned antagonism. Americans in the border states openly sympathized with the rebels of 1837, and themselves participated in enterprises for the "liberation" of Canada. (*See* HUNTERS' LODGES; CAROLINE INCIDENT.)

**Rebellion to Political Union.** In 1822 the British House of Commons proposed the union of Upper and Lower Canada, primarily because the English minority in Lower Canada still chafed at French preponderance in the elective assembly and at the continuance of French institutions. Clearly intended to stifle French-Canadian integrity, the proposal was denounced at mass meetings in Lower Canada. In Upper Canada the high property franchise included in the proposal displeased the majority. The proposal as a whole was dropped; but its financial provisions were passed separately in an attempt to effect an agreement between the two provinces in reference to customs duties, and to apportion this income by arbitration. By 1827 the dispute between the governor and legislative council and the elective assembly in Lower Canada over supply bills had reached an impasse; LOUIS JOSEPH PAPINEAU, leader of the reform party, and Lord Dalhousie were personal enemies. While a special committee appointed by the British Parliament in 1828 was investigating Canadian affairs, Dalhousie was succeeded by Sir James Kempt, whose conciliatory attitude toward Papineau preserved the peace; Lord Aylmer, governor from 1830-35, was less successful. The assembly added to its older demands one for an independent tribunal to try impeachment cases, and one for reconstructing the council on an elective basis. In 1831 the British Government fatally weakened its position by transferring all permanent revenues of the Crown to the control of the provincial assembly; the assembly accepted the transfer, but refused to vote the requested civil list. Papineau and other French nationalists became more outspoken; constitutional reformers withdrew from the reform party because of its increasing violence. In Upper Canada, meanwhile, such flagrant abuses of its power by the governing oligarchy as in the GOURLAY CASE had strengthened the reform party until, in 1828, it obtained a majority in the assembly. WILLIAM L. MACKENZIE and ROBERT BALDWIN, outstanding leaders, parted when Baldwin fell back from open revolution. The REBELLION OF 1837, although not a popular movement, led to revision and liberalization of Canadian government. The immediate result of the rebellion was the suspension of the constitution of Lower Canada, by Imperial order, and the appointment of John George Lambton, first Earl of Durham, as governor-in-chief of all British provinces in North America, with full powers as special high commissioner to cope with the critical situation. DURHAM'S REPORT, submitted after his resignation, Nov. 1, 1838, was used as the basis of

the UNION ACT OF 1840 and contained the germs of responsible government—i.e., colonial autonomy.

**Economic and Social Progress.** The fur trade of New France had established contact with the Chipewyas, Crees and Assiniboines in western Canada. British traders extended their commercial sphere to the Chipewyas, Yellowknives, other Athapaskan tribes of the North, the Blackfeet of the Rockies, and the tribes of the Pacific Coast. The dominant HUDSON'S BAY COMPANY was stimulated to exploratory activity by competition, by the NORTHWEST COMPANY, the X Y COMPANY, and American enterprises; but its interest in the far reaches of the North and West outlived the competing companies. Explorers in the service of or aided by the company, among them Samuel Hearne, ALEXANDER MACKENZIE, JOHN FRANKLIN, and Thomas Simpson and Peter Dease (*see* SIMPSON AND DEASE), struck out into the wilderness from the farthest points reached by their French predecessors. The Saskatchewan was explored to the mountains, the Churchill to one of its sources, the Clearwater to the Athabasca, thence to Lake Athabasca; Great Slave Lake was reached, the Peace River and the Parsnip explored; several passes through the Rockies were discovered, the Columbia and the Fraser followed to the Pacific; the Coppermine River, the Mackenzie, and the southern shores of Arctic islands discovered and explored. The single incursion of settlers into the traders' domain, the RED RIVER SETTLEMENT, had literally to fight the fur traders for existence. (*See* SEVEN OAKS, BATTLE OF.)

As a "reconstruction" measure following the Napoleonic Wars, the British Government in 1815 began a program of encouraging emigration to Canada; attractive concessions and active campaigning under the direction of Lord Bathurst, Secretary of State, resulted in several group settlements, notably the Perth Settlement and the McNab Colony, both Scottish colonies in Upper Canada. Financed in 1823 by the British Government, the emigration of indigent Irish brought an annual influx particularly notable in the Newcastle district of Upper Canada. The CANADA COMPANY, conceived as a colonizing enterprise of magnitude, fulfilled that promise. Several tracts had been opened by other private enterprises before, in 1829-33, there occurred an unprecedented overflow of population from the British Isles into Canada. During these four years 160,000 colonists, mostly Irish, from Great Britain arrived in Quebec. While Upper Canada received the bulk of the emigration, hitherto neglected parts of Lower Canada were populated. The occupation of wilderness areas and the rise of organized society overshadowed the influence of earlier groups, the Loyalists, the military colonists, the "backwoods" Americans, and provided the foundations of provincial existence largely emancipated from frontier status. From 1832-37 British immigration brought 125,000 people to Canada; the Act of Union restored the desirability of Canada to settlers after immigration had fallen almost to nothing during the Rebellion, and from 1840-50 fully 350,000 Europeans landed at Que-

bec. In the 17 years to Confederation another 450,000 arrived. The Huron tract of the Canada Co., then the public lands north and east of the tract, were opened up; the main tendency of immigration after 1840 was the steady occupation of the back country, the more remote counties. At least 40% of the immigration landing at Quebec ultimately found its way to the United States. Canada had little free capital, and could not match the phenomenal economic development of the United States during this period.

Montreal in 1841 had a population of 40,000; Quebec possessed 50,000; Toronto with 15,000 was the only other city with a population exceeding 10,000. Farming or lumbering engaged the great majority of Canadians; grain and lumber, with peltries from the West, were practically the exclusive exports. Along the coast the fisheries remained the largest source of income. British preference for Canadian flour and wheat, as expressed in the Canadian Corn Bill of 1843 which assessed Canadian milled and unmilled grain to one-fifth the duty paid by foreign producers, created a boom period extinguished by the adoption of a general free-trade policy in England as to importations of grains. The simultaneous reduction by Great Britain of duties on foreign timber and the repeal of the British Navigation Acts, depriving Canadian shipping interests of their advantages in the carrying trade of British West Indian products, prompted proposals by disaffected Canadians of annexation to the United States. Bumper crops and the RECIPROCITY AGREEMENT OF 1854 stimulated the economic life of Canada, and the annexation movement lost its swollen proportions.

On a reduced scale Canada reproduced the history of its neighbor nation in the rise of internal improvements in the 1830's, the wave of land speculation in railroads and lands in the 1850's; and the concomitant panics of 1837 and 1857.

### III. UNITED CANADA

**Politics and the Constitution, 1841-67.** Union, it had been hoped, would reconstitute parties and break up racial faction; the first Union Parliaments showed division among the politically more sophisticated English, while the French-Canadians maintained solidarity and so were the determining factor in many important measures. The first governors: Lord Sydenham, to 1842; Sir Charles Bagot, to 1843, and Lord Metcalfe, to 1847, were unable to secure majorities with which they could work in harmony. Leadership in the assembly was divided among brilliant individuals, the parliamentary careers of most beginning with the Union: Etienne Pascal Taché, John Sanfield MacDonald, John Neilson, Robert Christie, Denis Viger, Augustus Norbert Nurin, Francis Hincks, Robert Baldwin, Isaac Buchanan, Allan MacNab and Louis Hippolyte Lafontaine.

Sydenham exercised much independent authority; but Liberal intransigence forced from him the SYDENHAM-HARRISON RESOLUTIONS, pointing the way toward full responsible government. Bagot, already distin-

guished as a diplomat (*see* RUSH-BAGOT CONVENTION), yielded to the Liberalism in the assembly and accepted a ministry under the joint leadership of Lafontaine and Baldwin—the French-Canadian element of Lower Canada, and the moderate reformers of Upper Canada. Metcalfe could not reconcile his position as representative of the Sovereign with the implications of responsible government. The ministry, which had exercised hitherto unprecedented authority during Bagot's fatal illness, denied the governor's right to make appointments without consultation and demanded that office-holding become virtually patronage at the disposal of the party in power. After 10 months' deadlock between governor and assembly, the turbulent elections of 1844 gave Metcalfe a small majority recruited on the loyalty issue.

Lord Elgin assumed the governorship in 1847 resolved to carry the principles of his father-in-law, Lord Durham, to fruition; a general election was a triumph for the reformers and the second Lafontaine-Baldwin ministry began an important session. John A. Macdonald, Georges Etienne Cartier, Alexander Tilloch Galt and Papineau were notable additions to the assembly. Nearly 200 bills were enacted during the session of 1849; the judiciary system was revised, canal and railroad construction was encouraged, a municipal corporations act advanced local self-government, the University of Toronto was reestablished on a non-sectarian basis, and, against hectic opposition, a REBELLION LOSSES BILL was passed. By the close of Elgin's administration, 1855, officeholding had become party patronage. No appointments to office were thenceforth to be made by a governor without his having consulted his cabinet; matters of local concern were not to be referred to the home government; the governor ceased to attend cabinet meetings regularly. The Maritime Provinces meanwhile were striding toward responsible government. New Brunswick completed its evolution toward provincial autonomy. In 1850 the Prince Edward Island assembly gained control of the Crown revenues, and in 1864 gained a decisive victory over the absentee landlords who had hampered the development of the province. Led by Joseph Howe, the reformers of Nova Scotia in 1848 achieved responsible government.

The Lafontaine-Baldwin ministry disintegrated from within after 1849. The CLEAR GRITS faction under George Brown, and the PARTIE ROUGE of Papineau were ardently radical. The coalition could not settle the issue of the clergy reserves or of seigniorial tenure acceptably to a DOUBLE MAJORITY, and in 1851 was succeeded by the Moderate-Reform Hincks-Morin ministry, which despite a creditable legislative showing was displaced in 1854. A Liberal-Conservative alliance under the leadership of McNab and Morin was engineered by John A. Macdonald; in 1856 Macdonald himself assumed the leadership. Henceforward ministers were the responsible men in affairs of government, and governors were subordinated accessories. The secularization of the clergy reserves and the extinction of seigniorial rights, nominally Lib-

eral objectives, were accomplished by the new ministry in 1854. But new issues, including demands for abolition of denominational schools and for representation by population, marked a rapid succession of ministries and the gradual breakdown of party government. A Macdonald-Cartier ministry devised an amazing stratagem, the *DOUBLE SHUFFLE*, to avoid a general election; the trick could be worked only once. Political groups were virtually deadlocked after 1862; the Union policy had been demonstrated unworkable. A minority of leaders interested in railway development, westward expansion, or in military solidarity began work toward confederation; to that end Macdonald and Brown, ordinarily opponents, headed a coalition ministry which sent a Canadian delegation to the *CHARLOTTETOWN CONVENTION* of the Maritime Provinces. From that convention derived the *QUEBEC CONVENTION*, from the resolutions of which were drafted the *BRITISH NORTH AMERICA ACT* which was passed by the British Parliament in 1867 without a division.

Modifications of the Union Act, legally or as a matter of practice, had served to bridge the advance in political status from 1841 to 1867. Control of the post-office and of currency and banking had been assumed by the Canadian Government. In 1859 Great Britain had recognized the right of Canada to raise its own revenues, even by a protective tax on British imports. The Upper House of United Canada was reduced in size and made elective; but its powers and importance steadily declined after the establishment of cabinet government.

**Relations with the United States.** The north-eastern boundary dispute was adjusted by the *WEBSTER-ASHBURTON TREATY*, 1842; in 1846 the international boundary as established east of the Rockies was extended to Puget Sound. (See *OREGON BOUNDARY TREATY*.) In the *RECIPROCITY TREATY* of 1854 Canada and the United States exchanged extensive courtesies in trade and the fisheries. The agreement was abrogated by the United States in 1866 consequent upon ill-feeling developed during the Civil War. At the beginning of the war Canadian sympathies were strongly pro-Northern. Canada, committed to anti-slavery policies since 1793, was the haven of probably 20,000 fugitive slaves in the decade of the "Fifties," and had in 1860 a Negro population of nearly 60,000. Huge purchases of grain and cattle from Canada by the United States in the first months of the war added economic motives to emotional bonds. About 40,000 Canadians enlisted in the Union armies; but strained relations between Great Britain and the United States were reflected in Canadian sentiment, and aggravated by jingoistic newspapers such as the *New York Herald* which advocated the annexation of Canada to offset any losses from secession. Jacob Thompson and other Confederate refugees established headquarters on Canadian soil, perpetrated several outrages below the border, and maintained a propaganda organization in Canada. The governments of British North America maintained scrupulous neu-

trality, however. The most immediately troublesome of post-war issues were the *FENIAN RAIDS INTO CANADA*, an indirect manifestation of the hatred of Irish-Americans for the British Government.

#### IV. SINCE CONFEDERATION

**Ministries and Political Issues, 1867-96.** John A. Macdonald, leading statesman of United Canada for the 15 years preceding Confederation, was summoned by Lord Monck, governor-general, to build the ministry which should put the Dominion Government into operation. His cabinet, including Galt, Cartier and William McDougall, achieved a delicate balance in including the various factions which had foregone differences to work toward Confederation, and in satisfying racial and geographical claims. The first Dominion Parliament, meeting in Ottawa on Nov. 6, 1867, enacted a great mass of constructive legislation, including the first general banking law, which laid principles of conservative financial practice. The *INTERCOLONIAL RAILWAY* was begun, and essential steps taken for the incorporation of the western lands of British North America into the Dominion (see the subsequent heading, *Westward Expansion*). In 1870 occurred the *RED RIVER REBELLION*; upon its suppression Manitoba entered provincial status, and on July 20, 1871, British Columbia became a province of the Dominion. Prince Edward Island, motivated largely by financial embarrassments, belatedly entered the Confederation on July 1, 1873.

Opposition to Macdonald's leniency toward the prime movers of the Red River Rebellion and to the sacrifice of Canadian interests in the *TREATY OF WASHINGTON*, 1871, (which Macdonald, personally disappointed, justified before the Canadian Parliament "for the sake of peace") furthered the defection of the Liberals, led by Alexander Mackenzie and Edward Blake, the latter head of the Liberal ministry of Ontario. In 1873 charges made in Commons by a Liberal member that the Conservative leaders had been bribed by contributions to the party coffers to secure a charter for a Canadian Pacific railway to a certain group brought about the displacement of Macdonald and the succession of Mackenzie.

In the general elections of Jan. 1874, the Liberals were overwhelmingly victorious; but no definite program had been evolved. Mackenzie unwisely became engrossed in departmental duties, and severe economic depression greatly reduced the revenues. In 1874 Parliament authorized the construction of the Pacific railroad as a government enterprise, and a contract for construction from Pembina to Winnipeg was reluctantly issued when private capital could not be interested. The General Election Law of 1874 provided for simultaneous elections throughout the Dominion, abolished property qualifications for the Commons, and introduced voting by ballot. The Public Accounts Audit Act made the auditor of accounts independent of political influences; the Scott Act permitted local option elections by counties on the exclusion of liquor.

Having vigorously campaigned in advocacy of the NATIONAL POLICY the Conservatives were returned to power in 1878, and remained the administrative party for 18 years, during 13 of which Macdonald was premier. Protective tariff legislation happily coincided with the return of prosperity. In 1880 the contract for the Canadian Pacific Railway was let to a combination of English, American and Canadian capitalists on liberal terms which assured actual construction, and the agreement was ratified by popular optimism. After 1880 a succession of disputes between Dominion and provincial authorities reached intricacies which the British Privy Council was called upon to unravel; Macdonald consistently worked toward greater nationalism. This decade was marked by agricultural overproduction, a decline in manufactures and in foreign trade, and emigration of Canadians to the United States. Small factions became vehement: a Canada First group, urging greater projects of national development; advocates of an independent Canada; a British Empire League, urging an Imperial confederation; and, in the Saskatchewan Valley, the half-breeds and the Indians. The NORTH-WEST REBELLION and the subsequent execution of Riel alienated the French-Canadians of Quebec from any compromise with the Macdonald administration. In 1891 the Conservatives yielded to the growing demand for reduction of the tariff, and made further reductions in 1894. Reversing its old tenets, the party made overtures to Washington for a reciprocity agreement. Religious antagonisms, fanned by the EQUAL RIGHTS ASSOCIATION, battled in the political arena over the Jesuits Estates Act and injected the racial-religious issue into other proposed legislation. Corruption within the Conservative administration was exposed; but an appeal to patriotism and the use of campaign funds contributed by business and railroad interests prolonged the Conservatives' tenure in the election of 1891.

Exhausted by the strenuous campaign, Macdonald died in June 1891. His successor, Sir John Abbott, Montreal lawyer and member of the Senate, was overwhelmed by charges of corruption during the Macdonald regime in the departments of public works and of the interior and the printing bureau; in August Sir Hector Langevin, minister of public works, perforce resigned. Sir John Thompson, leader of the Conservatives in the Commons, became premier in 1892 when Abbott retired because of ill health. The BERING SEA CONTROVERSY was adjusted; but in domestic affairs Thompson and his successors, Bowell and Tupper, were unable to maneuver a settlement of the MANITOBA SCHOOLS QUESTION. Upon this issue and the tariff, and against the vigorous campaigning of SIR WILFRID LAURIER, leader of the Liberal Opposition since 1887, the Conservatives lost the general election of 1896.

**Political Programs and Issues, 1896-1914.** Laurier, titular head of the Liberals since 1887, constructed a brilliant cabinet including prime ministers of three provincial governments, W. S. Fielding, An-

drew G. Blair and Henri Joly de Lotbiniere, Sir Oliver Mowat; Richard W. Scott and, later, Clifford Sifton. The Manitoba Schools issue was settled, though not to the liking of the Catholic hierarchy. Tariff rates were reduced but not to the extent promised in the campaign, and a provision for preferential rates included in the expectation of stimulating trade between Canada and Great Britain. Opposition to expanding imperialistic relations, particularly the official recruiting and financing of Canadian volunteers for the Boer War, caused Liberal losses in Quebec in the general elections of 1900; but elsewhere Laurier gained markedly. Liberal interest in westward expansion was reflected in the authorization and support of a second transcontinental railway, the Grand Trunk, by a strict party vote, and the support of a third such line, the Canadian Northern. The Canadian Railway Commission was created in 1904 with judicial powers to fix rates, regulate operation and management, and, subject to appeal, to settle disputes over service. The Grand Trunk was the campaign issue of 1904; the Government added to its majority. In 1905 Alberta and Saskatchewan were admitted as provinces to the Dominion. Salary increases were awarded parliamentary and other public officials. In 1906 a "blue Sunday" law was enacted; in 1907 an Industrial Disputes Investigation Act (lately declared invalid by the Privy Council), drafted by WILLIAM LYON MACKENZIE KING, was enacted to prohibit strikes and lockouts on all public utilities until after an investigating board with extensive judicial powers had reported. A system of old-age annuities was established in 1908. The parliamentary sessions of this and the two previous years were chiefly marked, however, by the unearthing of corruption in governmental departments, particularly the departments of fisheries and the interior. The morale of the Liberal party was deteriorating, and the civil service was being manipulated by party leaders to perpetuate control. Big business undoubtedly was influencing legislation; the Conservatives in the elections of 1908 advocated public ownership of public utilities, publicity for campaign expenditures, reforms in the civil service, and a measure of governmental regulation of large businesses as remedies. With a reduced majority, the party was forced to yield to public pressure and consider problems of Canadian naval defense and military relations with the Empire. Henri Bourassa, leader of the agitation in Quebec for Dominion isolation, promoted the growth of a powerful opposition movement, the CANADIAN NATIONALIST LEAGUE. In 1910, after much hesitation, the Government sponsored and secured the enactment of a naval service bill for the development of a Canadian navy under control of the Dominion Government, and in 1911 a naval college was established at Halifax. Canada's status and obligations in the Empire was a subject of incessant discussion. Important legislation such as the creation of a conservation commission, 1909, was ignored as tariff agitation was revived. The West, in a state of agricultural unrest, demanded radical

revision of the tariff. Grain Growers' associations flourished as an insurgent movement against the older parties, demanding encouragement of the cooperative movement, lower duties and reciprocity with the United States, and government ownership of grain elevators and meat-packing plants. Attempting to meet part of these demands, the Laurier government formulated the TAFT-FIELDING RECIPROCITY AGREEMENT, which, violating patriotic sentiment in Canada, provided a capital issue for the Conservatives under the vigorous leadership of ROBERT L. BORDEN. In the 1911 elections the Conservatives returned to power.

Borden's measure, appropriating \$35,000,000 for the building of three first-class battleships to be contributed to the imperial fleet, was put through Commons by use of the closure rule, 1913; the Senate, having a Liberal majority, refused assent. In domestic legislation the Conservatives were more successful; the Bank Act of 1913 provided for better inspection of banks, greater security to depositors, and facilitation of loans to farmers and ranchmen. Agricultural instruction was promoted by Dominion appropriations. The Government built wheat-elevators in the West; the boundaries of Quebec, Ontario and Manitoba were extended northward; the Canadian Northern and other "internal improvements" received subsidies. At the outbreak of the World War, public opinion upheld the Government in its unhesitating support of Great Britain. In the emergency session of the Dominion Parliament, Aug. 1914, Laurier proclaimed a "truce to party strife," and during the first half of the war the Borden ministry was free to devote its energies toward the prosecution of the struggle.

**Westward Expansion.** From the extensive domain acquired in the NORTH-WEST TERRITORIES PURCHASE, 1869, the Province of Manitoba was created in 1870 and the remainder placed under territorial government. Four years later the Northwest Mounted Police was organized; there were then few but fur traders in the Far West. In the 1880's the invasion of the "cattle barons" began, an extension of the American ranching frontier by way of Montana. In 1882 four territories, Assiniboia, Saskatchewan, Alberta and Athabasca, were created, and in 1888 were granted legislative assemblies.

The Dominion Government supported immigration agencies in the United Kingdom and in Europe. To meet Australasian and South American competition, in 1872 Canada established a warrant system whereby approved immigrants gained large reductions in ship fares. Ontario and Quebec in that year agreed to pay two-thirds of the immigrants' railway fares from landing to homestead; the Dominion paid the other third. The United States homestead policy, from the system of surveying to the method of granting lands, was closely followed. Advertising pamphlets, bonuses and the liberal land policy produced during the 1870's an annual immigration of from 25,000 to 50,000; Ontario received the bulk of the influx. The completion of rail connections between St. Paul and Winnipeg,

raising the price of wheat in Manitoba 50%, was the signal for a westward rush of settlement. The farming population of the four original provinces in 1871 numbered 480,000; in 1881 the number was 620,000, and the newer sections held 40,000 more. The development of transportation facilities opened new trade in the shipping of live stock to Liverpool; the cheese and livestock industries began remarkable expansion. A militating factor was the constant drain of immigrants and native-born Canadians into the United States.

In 1868 the Canadian Parliament set a policy of Indian relations, looking toward the ultimate extinction of Indian title to the West, creating a liberal reservation system and executing Indian treaties with eminent fairness. In 1880 provision for the completion of the Canadian Pacific, implicit in the admission of British Columbia into the Dominion, was belatedly established. In the previous year the railway was granted the greater part of the desirable lands for 110 miles on either side of the right of way. In 1884 the Dominion Commons took the first definite step toward extension of national aid to agriculture. One of the last acts of the Conservative Government in 1895 was the subdivision of the little known northern regions, from the Atlantic to the Pacific, into four districts: Ungava, Franklin, Mackenzie, Yukon. The Klondike gold rush had already begun, and a provisional government was soon established. In 1901 the population of the Klondike-Yukon district reached the boom figure of 27,000. Questions of national jurisdiction arising from this influx (*see ALASKA BOUNDARY DISPUTE*) were settled in 1903 unfavorably to Canada.

Laurier's government exceeded its predecessors in furthering the material development of the West. Under the direction of Clifford Sifton, minister of the interior, immigration statutes and homestead laws were modified to attract increased and more compact settlement; advertising was placed in about 6,000 United States newspapers in 1897, and hundreds of prospects were given free excursions through the West. Immigration agents were given a bonus for every settler dispatched. In 1903 the Dominion agreed to build a railway from New Brunswick to Winnipeg while the Grand Trunk Pacific completed the route from Winnipeg to the Pacific; the Canadian Northern, from Quebec to Vancouver, was then being developed by William Mackenzie and Donald Mann, and within the next 11 years received bond-guarantees of about \$100,000,000 from the Dominion and \$135,000,000 from provincial governments, in addition to subsidies and land grants. The increase of population in Canada from 5,371,315 in 1901 to 7,204,838 in 1911 equaled the increase of the preceding three decades. Widely differentiated groups, including Mennonites, Icelanders, DOUKHOBORS, Austro-Hungarians, Scotch crofters and the BARR COLONY, were among the immigrants; especially notable was the large influx from the United States, reaching a peak of 133,000 in 1912.



Alberta and Saskatchewan were admitted to equal status with the older members of the Dominion in 1905. The Dominion Government retained control of the natural resources of the new provinces, but granted lavish compensation. More recently, 1929-30, agreements have been signed transferring the control of natural resources to the provinces. The boundaries of Quebec, Ontario and Manitoba have been extended northward; the settlement of the northern parts of the Prairie Provinces is largely contingent upon the successive improvements in wheat seed to meet climatic conditions. Conditions of farming in the Prairie Provinces, making the present-day settler the most specialized pioneer in history (grain production is the concentrated interest), have fostered co-operative enterprises and induced the Government to embark upon ambitious projects of public control or ownership.

**Canada in the World War: the Home Front.** The commercial depression of 1913 was aggravated in the early months of the war. Serious financial difficulties due to the withdrawal and hoarding of gold were averted only by extra-constitutional orders-in-council. The issue of Dominion notes unprotected by gold was increased; the British treasury advanced about £12,000,000 to the credit of the Dominion for war supplies, and a reciprocal system of credits was devised whereby Great Britain purchased munitions and foodstuffs in Canada. J. P. Morgan and Co. of New York underwrote a loan of \$45,000,000 to the Dominion in July 1915; later loans of \$175,000,000 were raised in New York. The first Canadian domestic loan, \$50,000,000, was issued in Nov. 1915; oversubscriptions raised the amount by the same figure, and two additional loans floated in 1916 and 1917 aggregated, including oversubscriptions, \$450,000,000. The grand total of domestic loans raised in Canada during the war reached \$1,800,000,000. Voluntary contributions to war-service institutions and the Canadian Patriotic Fund reached \$100,000,000. Domestic taxes included a rise of postal rates, and excises on banking and insurance companies, on commercial paper of many sorts, and certain merchandise. The budget of 1916 introduced an excess profits tax, and in 1917 an Income War Tax Act.

By the close of 1916, 630 munitions factories had been established in the Dominion; their output was primarily responsible for the favorable financial balance with Great Britain, which at the end of the war owed the Dominion \$400,000,000 for supplies. Expansion of food production and curtailment of domestic consumption was undertaken by the Government; wheat prices were fixed by fiat, and on Nov. 5, 1917, an order-in-council forbade the use of grain in the manufacture of spirits. Railway operation was pooled under the Canadian Railway Association organized in 1917, and before the close of the war the Canadian Northern passed into Government possession.

As early as July 1915, war contracts issued by the Government aggregated almost \$395,000,000; charges

of profiteering and corruption were rife by the close of the year. Organized labor in particular reflected dissatisfaction with the rise of war-time millionaires and the increase in living costs, and despite boards of conciliation and other devices to avoid strikes, in 1917-18 there were 311 strikes, and a general strike of railway employees was averted only by great concessions in scale and hours. The Conservative Government prolonged its life by appeals to national patriotism to forego the statutory elections of 1916; by a Military Voters Act giving the franchise to all Canadian adults in or out of Canada engaged in war service and denying the franchise to conscientious objectors; and by a War Times Election Act granting the franchise to all adult female relatives of Canadians serving overseas and disfranchising anyone using the language of an alien enemy country. Provision for military conscription, introduced June 11, 1917, was the signal for the breakdown of party lines; the Western Liberals favored conscription, while the Quebec Liberals were irreconcilably opposed. Borden effected a coalition of the Conservatives and the pro-conscription Liberals. This Union Government was upheld in the general election of 1917, in which Laurier's Liberals, the Opposition, carried 62 of the 65 seats of Quebec. Draft riots in Quebec greeted the attempted enforcement of conscription; in other parts of the Dominion the number of draftees claiming exemption exceeded all expectations, and only 18% of the Canadian Expeditionary Forces were conscripts.

The war itself, however, never lost its popular character. Heatless days; daylight saving, and similar economies; the intensive educational campaign of the Department of Public Information, organized early in 1918; riots against German-born Canadians, and legislation against the use of languages other than English were diverse manifestations of popular support.

**Canada in the World War: Overseas.** Only 3,500 troops were in Canadian service at the beginning of the war; the organization of the militia, however, permitted of speedy expansion to 150,000 men. By the end of 1915, there were 212,000 men under arms, and another 500,000 had been called. Enlistment during the earlier months outstripped the Government's ability to equip the volunteers. Of the first 250,000 volunteers, over 150,000 were born in Great Britain; the greatest response was from the West rather than the East, and from the urban population rather than the rural.

The first Canadian contingent, excluding a hospital unit, went overseas in Oct. 1914, and trained on the Continent; this "Princess Pat" regiment suffered terrible losses in the spring campaign. The First Canadian Division landed in France in Feb. 1915; its artillery participated in the battle of Neuve Chapelle, and the division played a leading part in the Second Battle of Ypres, standing ground in spite of gas attacks, and under the leadership of Gen. Alderson undertaking counter-attacks which reduced the pace of the German advance until British reserves could

stop the gaps in the Allied line. Here and in the engagements about Langemarck and St. Julien the Canadians lost over 5,000 men. In May and June, having been brought up to strength by reinforcements, the Canadian division participated in minor victories north of La Bassée Canal. The remainder of the year was passed in trench warfare, in which they distinguished themselves.

By spring, 1916, there were three Canadian divisions in France. Under command of Gen. Byng they took part in the Battle of St. Eloi (a German victory); the Battle of Sanctuary Wood, which marked the first use of the perfected German drum-fire and, beginning as a decisive defeat, ended as a Canadian recovery; and, with a fourth division, in the Battle of the Somme. During the winter of 1916-17 the Canadians held the trenches to the west of Vimy Ridge; the Allies' counter-offensive, elaborately planned, was launched at this point on Apr. 9, when in the Battle of Arras the Canadians carried all three lines of German defense. By Apr. 13 they had gained the crest and advanced upon the plains to the east of the ridge. Later operations on the Arras front, in which the four Canadian divisions were for the first time commanded by a Canadian, Gen. Arthur W. Currie, failed to dislodge the Germans. The Lens sector, occupied by the Canadians, was comparatively quiet until Aug. 1918, when Canadian troops were at the apex of the wedge which penetrated the German lines at Amiens. Opposite Arras one week later, Aug. 26, the Canadians attacked the main Hindenburg line. Early in September they captured the key positions of Dury and Cagnicourt, and gained many lesser objectives later in the month. On Oct. 9, Dominion troops entered Cambrai after one of the most sanguinary battles of the war, with Canadian casualties alone numbering 16,000. Pushing across the Belgian border, on Nov. 11 the Third Canadian Division entered Mons. Gen. John J. Pershing has written, "It was always stimulating to visit the headquarters of the Canadians, where one soon caught the fine spirit of that superb body." In all, 424,589 troops served overseas in the Canadian Expeditionary Forces; almost 200,000 others were mustered in Canada. The Dominion's total war casualties were about 225,000; over 51,000 of these were killed. The 17,000 honors distributed among Canadian troops included 64 Victoria Crosses.

**Ministries and Politics since 1918.** The demobilization and return of Canadian troops was effected with reasonable speed. A special bureau of soldiers' civil reestablishment, under Sir James Lougheed, undertook the rendering of medical service to disabled veterans, the training of maimed men for new vocations, and the finding of employment for discharged soldiers. Subsidies were granted to meet the immediate needs of discharged men, a high scale of pensions fixed, and in 1920 a system of state insurance for returned soldiers established. A Land Settlement Board lent, by 1922, \$88,000,000 to some 27,000 soldiers who had become farmers.

Preferential treatment was given returned soldiers in filling civil service positions; appropriations were made to help build workers' homes, and the Dominion Government extended financial aid to provincial governments working out their own relief programs. Financial reconstruction was slow because of the immense public debt which had accrued; most war taxes were retained, and tariff revisions were slight. Annual interest charges of about \$140,000,000 were being met in full by war taxes still in force in 1931, and a portion of the treasury balance was being applied toward reduction of the principal of the debt. In 1925, at its high figure, this was \$2,417,437,685. All large railroads except the Canadian Pacific have been incorporated into the Canadian National system, representing a total mileage of 22,375 miles, under a non-political management.

The Union Government organized by Borden in 1917 was in advanced disintegration when the Conservative Party, in caucus on July 1, 1920, reorganized itself as the National Liberal and Conservative Party, on a platform advocating autonomy within the Empire, revision of the tariff to prevent the development of monopolies but without sacrificing protection of Canadian industry, a "preparedness" program, and other measures designed to strike a mean between reactionary and radical demands. Borden resigned, July 10, 1920, and was succeeded in the premiership by ARTHUR MEIGHEN. Since the death of Laurier in 1919, King had been leader of the Liberal Opposition. The party was reinvigorated in 1919 by a general convention which advocated specific measures of tariff reduction and enlargement of the free list, labor representation in industry and on government commissions, proportional representation, state insurance, Dominion ownership of cooperatives, the restriction of Chinese immigration and rural credits legislation, and opposed any change in the Imperial status of Canada except by Parliamentary action and a popular referendum. Both parties thus restated their tenets in preparation for the crucial campaign of 1921. That election was marked by the entrance of the agricultural class, the National Progressive Party, into its first national campaign. This party, developed from the Grain Growers' associations and encouraged by the success of farmers' cooperatives, demanded aid to agriculture and land settlement, reduction of the valuations of the railroads, lower tariffs and reciprocity with the United States, and democratic innovations in government. In the election year the Canadian Labor Party was organized, an outgrowth of local labor parties which had developed concomitantly with several extensive strikes during the post-war depression. The party demanded workers' representation in industrial management, labor exchanges, old age pensions, regulation of rents and similar legislation.

The Conservatives, defending the nationalization of the railroads and protection in tariffs, were overwhelmingly defeated. The Labor candidates showed little strength; but the National Progressives, under the able leadership of T. A. Crerar, carried 65 seats.

The new Liberal Government, with King premier, had a party majority of but one, and perforce made overtures to the Progressives. As the Senate remained a Conservative stronghold, Liberal legislation reported by Commons was frequently checkmated. Until 1924 the Government carefully avoided controversial legislation which might endanger its plurality, and the Progressive party failed to stimulate the field of legislation as had been expected. In 1924 the budget removed entirely the sales taxes on equipment used in agricultural and other "natural" industries, and reduced the tariff on agricultural implements and raw products used for their manufacture. Progressive support gained by these measures was largely nullified, however, by an increase in freight rates on the Canadian National Railways. After having secured the passage of a redistribution bill enlarging the membership of the Commons, King appealed to the country. The election of 1925 revealed perplexing party and sectional cleavage; the Liberals received 101 seats, the Conservatives 116, and the Progressives and independent candidates 28. Despite the reduction in the Liberal strength, King attempted to reconstruct his government and awaited the reassembling of Parliament in Jan. 1926. The Liberal hope was that the Progressive bloc would repudiate the possibility of Conservative control because of the tariff issue.

After several months of nominal control, marked by the passage of a rural credits bill and an old-age pension in the Commons and the rejection of both by the Senate, King resigned when Progressive support was alienated by disclosures of scandals in the customs service. Meighen in turn was displaced, July 2, after a stormy premiership of three days, and Parliament was dissolved by the governor-general, Lord Byng, amidst a wild controversy over constitutional procedure. The ensuing campaign, a muddle of issues and personalities, gave the Liberals 119 seats in Commons, Conservatives 91, Progressives 8, Liberal-Progressives 11, United Farmers of Alberta 11, Labor 3, Independents 2. The Liberal gain was largely attributable to the tax and tariff reductions under King—the "Robb budget." Again premier, King destroyed the effectiveness of the agricultural bloc by assuring the Manitoba Progressives of his sympathy with their views upon the tariff, freight rates, and completion of the Hudson Bay Railway. The leadership of the Opposition passed to Richard Bedford Bennett of Calgary, the only Conservative to be returned from the Prairie Provinces in the elections of 1926. The tactics of the Opposition lacked the virulence characteristic of the years of breakdown of the two-party system; Conservatives in general cooperated with the Liberal government in constructive legislation. The revision of the budget, old-age pensions, encouragement of immigration, new trade treaties and new social legislation preoccupied the Administration of Mackenzie King until the winter of 1929-30, when problems arising out of economic depression and unemployment increasingly engrossed

the attention of Cabinet and Parliament. The elections held on July 28, 1930 gave a clear majority to Bennett and the Conservatives who returned 136 members out of a total of 245. The Liberal representation fell to 89, while other groups totaled 20.

**Labor and Agriculture.** The industrial expansion of Canada was in large part financed by British and American capital. United States corporations established branch factories or assembling plants in Canada, accelerating the rapid change of Dominion industries to a factory system and a capitalist regime. As labor developed class consciousness, trade unionism flourished. The strike of Toronto printers for a 9-hour day in 1872, beginning with the imprisonment of 24 strikers for conspiracy and lasting 17 weeks, won popular sympathy and led to the repeal of the harsh measures against combinations of laborers previously in force. The first national representative body, the Canadian Labor Union, embraced 35 unions; short-lived, it was succeeded by the extension of powerful United States unions into Canada. The Trades and Labor Congress of Canada, launched by 29 unions in 1883, has been the guiding influence of Canadian labor toward improved conditions. A more radical organization, the One Big Union, organized mainly by delegates from Western Canada in 1919, would substitute industrial unionism for the existing system of craft unions particularly to increase the political force of labor. From 1901-29, 3,214 industrial disputes occurred in Canada involving over 925,000 employees. Farmers, particularly those in the Prairie Provinces, have manifested similar unrest. Six federated associations of farmers arose from 1901-11, expounding demands paralleling those of farmers' non-partisan leagues which developed simultaneously in the United States. The launching of farmer-controlled newspapers, the raising of campaign funds among themselves and the presentation of independent slates in elections have characterized their activities. The promotion of cooperative organizations in agricultural production and distribution, the formation of rural credits societies and the enactment of good-roads programs have been concrete gains of a farmers' insurgency whose platform sponsors many governmental reforms designed to curb vested interests.

**Canada's Position in the Empire.** During the World War Premier Borden participated in meetings of the Imperial War Conference, in which leaders of the Dominions met with the members of the British war cabinet on equal terms. At the Peace Conference of 1919 two Canadians (Borden, Arthur L. Sifton, Sir George Foster and Charles J. Doherty, alternately) served as members of the British delegation. Canada received separate representation in the Assembly of the League of Nations, and secured recognition of the eligibility of the Dominion to a seat on the League Council. A marked extension of Canada's insistence upon "equality of nationhood" was the separate ratification of the peace treaties by the Dominion Parliament. The Western Provinces in particular were in-

sistent that the Dominion accede to no Imperial control which might be binding in matters of international policy. The NORTH PACIFIC FISHERIES TREATY was legally between the United States and Great Britain; but the sole "British" plenipotentiary was the Canadian minister of marine and fisheries. Arising from this anomalous circumstance was the formal agreement at the Imperial Conference of 1923 that any part of the Empire might negotiate and sign alone treaties affecting no other part of the Empire. Canada has successfully maintained its right to discriminate even against other sections of the Empire in its immigration policy. At the Imperial Conference of 1926 Mackenzie King and Ernest Lapointe, the Canadian delegation, shared with representatives of South Africa and Ireland the outspoken attitude which produced full and formal recognition of equal status between Great Britain and the Dominions. In 1927 Vincent Massey was appointed first minister of Canada to the United States. Maj. W. D. Herdridge was appointed his successor in Mar. 1931. The Minister to Canada from the United States at that time was Col. Hanford MacNider, appointed in 1930. At the Imperial Conference held in London, Oct. 1-Nov. 15, 1930, Premier Bennett took the lead in proposing an extension of the principle of reciprocal trade preferences within the Empire. Although the Canadian proposal received some support from the other Dominions, the British Government refused to consider tariffs on foodstuffs entering the United Kingdom, but arrangements were made to summon another Conference at Ottawa for the further discussion of inter-Imperial economic relations.

E. D. B.

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*The Unreformed Senate of Canada*, 1926; W. B. Munro, *American Influences on Canadian Government*, 1929; A. Siegfried, *The Race Question in Canada*, 1907. The *Canada Year Book* is an official publication of very great value. Among the leading Canadian newspapers are the *Montreal Gazette*, Conservative; the *Toronto Globe*, Liberal; the *Manitoba Free Press*, Liberal, and the *Vancouver Daily Province*, Independent-Conservative. For current affairs consult also the *Canadian Forum*, a progressive though not partisan monthly; the *Queen's Quarterly* and the *Dalhousie Review*. The *Canadian Historical Review*, published quarterly at the University of Toronto Press, carries valuable articles and full bibliographies. Attention should be called also to the *Dictionary of Canadian Biography*, compiled by W. S. Wallace, 1926.

**CANADA BALSAM**, an oleo-resin from the balsam fir (*Abies balsamea*) of the northeastern United States and Canada. It forms in small blisters on the bark and is secreted freely when these are pricked or the tree is injured. Naturally a white, very transparent liquid, it becomes more solid and harder with age. It has a delicate, piney odor and contains 24% of essential oil, 60% of alcohol-soluble resin and 16% of resin soluble in ether only. Occasionally used in medicine, Canada balsam is chiefly used to cement cover-glass on microscopic specimens, for which its transparency and refractive index make it particularly suitable.

**CANADA COMPANY**, a colonizing enterprise of magnitude which greatly furthered settlement in Canada. John Galt, Scotch man of letters, proposed to Lord Bathurst, English Colonial Secretary, the formation of a company for the purchase and settlement of all the Crown reserves and half the clergy reserves in Canada unsold or unoccupied on Mar. 1, 1824. An investigating commission fixed the amount of such land at 1,384,013 acres of Crown reserves and 829,430 acres of clergy reserves, and recommended a price of 3s. 6d. per acre. The clergy protested the sale of their endowment at the small sum fixed, and since the consent of Parliament would have been necessary for alienation of any clergy reserves, Lord Bathurst substituted a single block of 1,100,000 acres, the Huron Tract. The Canada Co., chartered in 1826, paid the Provincial Government somewhat over £300,000 in annual installments over a 16-year period. The town of Guelph was first to be founded, by Galt himself; Galt, Goderich, and later Stratford and St. Mary's were important centers of the company's early activities. The company brought to Canada a large proportion of the best elements of its population.

**CANADA CONSTITUTIONAL ACT OF 1791.** The influx of LOYALISTS into Canada entailed most important political adjustments. The QUEBEC Act, however acceptable to the French-Canadian population, provided no machinery of government satisfactory to the newly-arrived people accustomed to popular assemblies, the English jury system, and other institutions of representative government and local autonomy. The British Parliament, by the Act of 1791, effective Dec. 26, divided Canada into two provinces, Upper and Lower Canada, each with a separate government: a governor and lieutenant gov-

error, appointed by the Crown; a legislative council, appointed for life by the governor (in Lower Canada, not less than 15 members; in Upper Canada, at least seven); and an elective assembly of at least 50 members in Lower Canada and at least 15 in Upper Canada. The franchise was contingent upon property holding. The governor or lieutenant could convoke or dissolve legislatures, refuse assent to bills, or reserve bills for the pleasure of the Crown; the Crown reserved general powers of veto within two years of a bill's passage. The English Parliament retained power to levy customs and to regulate navigation and commerce. While the rights of the Roman Catholics were guaranteed, provisions were made for the endowment of a Protestant Church in Canada. The boundary between the two provinces was left to the determination of the Crown. The line was fixed at the Ottawa River, but a small region about Montreal was left as part of Lower Canada because the French system of landholding prevailed in this area.

The Act of 1791 was the first grant of representative institutions by a British Parliament to a colonial dominion. It was patterned closely after English institutions, and represented a marked advance in Imperial theory. In application, however, it appeared of dubious merit. Its manner of providing for the establishment of a Protestant Church created a political issue which gravely disturbed Canadian affairs during the 19th century. It left in Lower Canada, subject to French rule, a dissatisfied English minority, and prevented the coalescing of the French and English stocks.

**CANADIAN LITERATURE.** Canadian literature, so-called, consists of two streams, French and English, differing in their origins and aims. Nevertheless, they have been shaped by the same forces and attracted by the same themes. In their reticence regarding sex and their love of nature the Catholicism of Quebec and the Protestantism of Ontario are curiously akin.

**French-Canadian Literature.** In the beginning French-Canadian literature was merely a phase of French literature. Since the population along the St. Lawrence was recruited from peasant stocks, it produced nothing of importance except folk-songs and legends. Aside from its tales of the *loup-garou*, only the narratives of the early explorers and the *Relations* of the Jesuit Fathers are of much significance. Until the middle of the 19th century, poetry and prose were parochial in temper and clerical in tone. The conditions which they reflect led to the mordant lines of Michel Bibaud (1782-1857), the first French-Canadian man of letters.

Although Bibaud was also an historian, he attacked the tendency of French-Canadians to feed their patriotism upon their grievances, and therefore never won a following. On the other hand, François Xavier Garneau (1809-66), author of *l'Histoire du Canada*, 1845-48, founded at Quebec a school that devoted itself enthusiastically, if uncritically, to the Lost Cause.

Associated with it were such poets as OCTAVE CRÉMAZIE (1827-79), Leon Pamphile Le May (1837-1918), Antoine Gérin-Lajoie (1824-82), and Honoré Louis Fréchette (1839-1908). Crémazie, the first versifier of unquestioned genius, is known by his glowing description of the Thousand Islands and his spirited song, *Le Drapeau de Carillon*. Le May, less original, accentuated the antagonisms of his day by translating Longfellow's *Evangeline*. In *Un Canadien Errant* Gérin-Lajoie wrote at least one lyric that is not likely to be forgotten. Of the four writers, Fréchette, who was journalist, historian and dramatist as well as poet, achieved the widest reputation. As the first French-Canadian whose work was accepted in Europe, he is assured of remembrance. Moreover, *La Légende d'un Peuple*, 1887, which he conceived as a national epic, possesses undoubted merit.

As suggested by their interests, the members of the Quebec School, including Philippe Aubert de Gaspé (1786-1871), author of *Les Anciens Canadiens*, 1862, were at heart romantics, dominated by a past that never existed and a future that is never likely to be realized. The members of the Montreal School who succeeded them were oblivious to the wrongs of their race. Indifferent not only to the Church but also to religion, they turned for inspiration to the naturalists and even the decadents, seeking beauty wherever they could find it. Émile Nelligan (b.1882), insane at 19, stumbled upon it in the recesses of his soul and in the harmonies of sound and color. Through the windows of his sickroom, Albert Lozeau (1878-1924) discovered it not only in the nuances of nature but also in the mysteries of love, so generally eschewed by his fellows. That French-Canadian literature has finally escaped from its provincialism is indicated by the work of Paul Morin (b.1889), whose exquisite volume, *Le Paon d'Email*, 1911, belongs to the world at large.

**English-Canadian Literature.** Like French-Canadian literature, English-Canadian literature is derivative and often imitative. The Puritans, from New England, the Loyalists and the Scots continued in British North America the fashions to which they had been accustomed. As is to be expected, the Puritans produced a considerable body of hymns, sermons and religious treatises. The work of the Loyalists, distinctly secular in tone, includes numerous memoirs colored by their experiences in the Revolution. Like all pioneers, they engaged in exploration; and the *Travels*, 1809, of Alexander Henry (1739-1824) is one of the most fascinating books on the fur trade. In general, however, the Scots were more active in its development. Consequently, the *Voyages*, 1801, of SIR ALEXANDER MACKENZIE (1755-1820) has rivalled it in popularity. Pathfinders in many fields, the Loyalists and the Scots established not only the first newspapers but also the first periodicals, the *Nova Scotia Magazine*, 1789-91, and the *Quebec Magazine*, 1792-94.

During the period from 1812-67 English-Canadian literature was essentially journalistic. All the more



important writers were associated with the press. Most far-reaching in his influence was JOSEPH HOWE (1804-73), poet, orator and statesman who founded the *Novascotian*. His *Speeches and Public Letters*, 1859, is as important from a literary as from a political point of view. Although Thomas Chandler Haliburton ("Sam Slick") (1796-1865) was almost as prominent, he is known only as a humorist. *The Clockmaker* (1836-40), now a classic, is full of meaty characterizations, but it is less authentic than *The Old Judge*, 1849. What the *Novascotian* was to the writers of the Maritime Provinces the *Literary Garland*, 1838-51, published in Montreal, became to their colleagues in the Canadas. Among its contributors were the Strickland sisters, Susanna Strickland Moodie (1803-85) and Catharine Parr Traill (1802-99), cultivated Englishwomen who devoted themselves to life in the "Bush." To them must be added the principal romancers of the day, Rosanna Eleanor Leprohon (1832-79), whose tales of the Conquest are not without interest, and John Richardson (1796-1852), the vitriolic interpreter of the Frontier, whose *Wacousta*, 1832, has survived in spite of its author's flair for melodrama.

Poetry did not attain to such distinction. Although Charles Sangster (1822-93) has been called the father of English-Canadian poetry, the title seems more applicable to Charles Mair (1840-1902). The first notable poet from the point of view of attainment and influence was Charles G. D. Roberts (b.1860), author of *Orion and Other Poems*, 1880. In spite of its immaturity, its range and finish marked the passing of the amateur. Although Roberts never shed the mantle of his masters, he at least acquired control of his own media; and his shorter poems dealing with the Canadian scene must be ranked high. They are more likely to endure than the lyrics of BLISS CARMAN (1861-1929), who never excelled the haunting music of his *Low Tide on Grand Pré*, 1893. His excursions in Vagabondia, important historically because of their effect upon the development of the New Poetry in the United States, already seem thin and colorless. Among his contemporaries William Wilfred Campbell (1860-1918), Duncan Campbell Scott (b.1862) and Archibald Lampman (1861-99) won at least local recognition. Of the three Lampman seems the most secure in his position. Although his indebtedness to the great romantics is obvious, no one else has interpreted so subtly and so philosophically the charm of the northern landscape, with its violent alterations of heat and cold.

Even to their admirers, the work of Carman and Lampman seemed to lack reality. Consequently the warmth and raciness of *The Habitant and Other Poems*, 1897, by William Henry Drummond (1854-1907), made a wide appeal. Its vogue, however, was soon overshadowed by that of *The Songs of a Sourdough*, 1907, by ROBERT SERVICE, who frankly imitated the *brutalité* of Kipling. Nevertheless, a number of writers continued the older tradition. Francis Sherman (1871-1926) left a small sheaf of uniform

excellence. Marjorie L. C. Pickthall (1883-1922), whose *Drift of Pinions*, 1914, was everywhere recognized as a noteworthy achievement, invited comparison with the ablest writers of her sex. JOHN McCRAE (1872-1918), author of *In Flanders Fields and Other Poems*, 1918, produced one of the finest poems of the War.

Since prose fiction is less individualistic, it has made less progress. The historical romance flourished under the influence of its practitioners in England and the United States. Even James De Mille (1830-80), who devoted himself to extravaganzas, was drawn into the current. The most successful romancer, however, was William Kirby (1817-1906), whose *Golden Dog*, 1877, revealed the splendor of Canada's past. The vein opened by Kirby was explored by SIR GILBERT PARKER, who was the first English-Canadian novelist to win and hold a wide audience. RALPH CONNOR, attracted by the local colorists to the South, also appealed to a large circle of uncritical readers. L. M. Montgomery (b.1874), beginning propitiously, likewise fell a victim to an unformed taste. Even recent writers like Laura Salverson, author of *The Viking Heart*, 1923, who has shown signs of power, and Mazo de la Roche, whose *Jalna*, 1927, has every virtue but credibility, have not maintained their early promise. Only NORMAN DUNCAN (1871-1916) and E. W. Thompson (1849-1924), who have written racily of the soil, have much claim to distinction. As revivers of the animal story, however, Charles G. D. Roberts and ERNEST THOMPSON SETON occupy a well-won niche in contemporary letters.

The development of non-fiction represents the advance of English-Canadian culture in all fields of scholarship. Since it is dependent upon English and American sources, there is still a conflict of ideals that hampers the growth of individuality. Moreover, the greatest thinkers such as John Beattie Crozier (1849-1921) and SIR WILLIAM OSLER (1849-1910) have often been drawn elsewhere. Nevertheless, the Dominion can point to such essayists as Sir Andrew Macphail (b.1864), Philip Grove (b.1872), Archibald MacMechan (b.1862), and STEPHEN LEACOCK (b.1862), whose reputation as a humorist has obscured his capacity as a critic. In biography and more especially in history English-Canadian literature has given evidence of increasing maturity. R. P. B.

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**CANADIAN NATIONALIST LEAGUE, THE**, was organized in 1903 by citizens of Montreal under the leadership of Oliver Asselin in protest against the trend of the Dominion toward increased participation in international affairs. A French-Canadian movement, with Henri Bourassa its principal political exponent, the league grew rapidly and reached its highest effectiveness just before the World War. It demanded in foreign policy the greatest po-

litical, military and commercial autonomy consistent with the preservation of the bonds of Empire, and within the Dominion the greatest possible provincial autonomy. The Nationalist movement opposed the Lord's Day Act of 1906, the Conservatives' naval policy, and the influence of vested interests in the fiscal system of the Dominion; it favored a restricted immigration policy, the conservation of natural resources and the nationalization of the railroads, and asserted the legal parity of the French language and the right of Catholic minorities to separate schools.

**CANAIGRE** (*Rumex hymenosepalus*), called also wild rhubarb, a weedy perennial herb of the BUCKWHEAT family commonly found in sandy places from Oklahoma to California. The erect stem, 2 to 3 ft. high, rising from tuberous roots, bears large docklike leaves and long clusters of rose-colored flowers. The roots, for which the plant is sometimes cultivated, are used as a source of tannin; the stems are cooked as a substitute for rhubarb.

**CANAL BOATS.** See BARGES; BARGE LINES.

**CANAL DU MIDI.** See LANGUEDOC CANAL.

**CANAL RAYS.** See POSITIVE RAYS.

**CANALS.** Navigable Waterways comprise, 1. Canals and 2. canalized rivers in which the bars to navigation—shoals, rapids or strong currents—are overcome by construction of a series of Locks and DAMS with "slack water" pools extending from one lock to the next along the canal's length.

Navigation Canals vary from a simple channel connecting two bodies of water at practically the same level, e.g., Suez, to "locked" canals that: 1. Connect two bodies with only tidal differences in level, e.g., Kiel Canal; or 2. Connect a higher with a lower body in a simple descent, as the New Welland Canal; or 3. Overcome a divide as in the case of the Panama Canal. A number of canals follow river valleys providing navigable ways around rapids, e.g., the old Chesapeake and Ohio Canal, and the Sault Ste. Marie Canals. In Europe many rivers are interconnected by canals, e.g., Rhine-Marne, Rhine-Danube, Mittellandkanal System. Canalized rivers may be exemplified by the Ohio in America, and the Seine and Meuse in Europe. Many canals are hybrid types, partly artificial waterway and partly canalized river, as the main New York Barge Canal, and the Illinois Waterway between Lake Michigan and the Mississippi. The Marinsky Waterway System connecting the Bal-

tic Sea and Volga River in Russia is a combination of natural waterway, artificial canal and canalized river. The network of boat canals covering central and northwestern Europe includes all types.

Navigation canals may be classified as boat (or barge), or ship. The difference lies in dimensions and clearances and in class of ships accommodated. Two typical and important *boat or barge canals* are the Dortmund-Ems, Germany, with minimum channel depth about eight feet; and the New York Barge, 12 feet. Depths of ship canals extend from about 20 ft. to the 45 ft. of the Panama Canal, and clearances for funnels, masts, etc., as well as controlling channel and lock dimensions, must also be much greater.

See also RIVER IMPROVEMENT; WATERWAYS; INLAND WATER TRANSPORTATION. F. R. H.

NOTABLE CANALS

Name	Location	Depth Ft.	Length Miles	Locks	Completed Year
<sup>1</sup> Amsterdam	Netherlands				
	North Sea-Zuider Zee	32	17	0	1876
<sup>1</sup> Cape Cod	Massachusetts				
	Barnstable Bay-Buzzards Bay	25	8	0	1914
<sup>2</sup> Chesapeake & Delaware (New)	Maryland-Delaware				
	Chesapeake Bay-Delaware River	12	18	0	1927
<sup>1</sup> Chicago Drainage and Ship	Illinois				
	Lake Michigan-Illinois River	22	39	1	1900
<sup>1</sup> Corinth	Greece				
	Corinth Gulf-Aegina Gulf	26	4	0	1893
<sup>2</sup> Dortmund-Ems	Germany				
	Dortmund-Ems River	8	170	17	1899
<sup>2</sup> Hohenzollern (Spree-Order)	Germany				
	Spree River-Order River	10	82	8	1914
<sup>1</sup> Kiel	Germany				
	Baltic Sea-North Sea	36	61	2	1895
<sup>1</sup> Lake Washington	Washington				
	Puget Sound-Lake Washington	34	8	1	1916
<sup>1</sup> Manchester	England				
	Manchester-Mersey River	28	36	4	1894
<sup>2</sup> Marinsky	Russia				
	Baltic Sea-Volga River	5	800	43	1810
<sup>1</sup> New Orleans Industrial	Louisiana				
	Mississippi R.-Lake Pontchartrain	30	6	1	1923
<sup>2</sup> New York Barge	New York				
	Lake Erie-Hudson River	12	541	57	1918
<sup>1</sup> Panama	Isthmus of Panama				
	Atlantic Ocean-Pacific Ocean	45	50	6	1914
<sup>2</sup> Rhone-Marseilles	France				
	Rhone River-Marseilles Hbr.	10.5	51	3	1916
<sup>1</sup> Suez	Egypt				
	Mediterranean Sea-Red Sea	39	105	0	1869
<sup>1</sup> Welland (New)	Canada				
	Lake Erie-Lake Ontario	30	25	8	1930

<sup>1</sup> Ship Canals. <sup>2</sup> Boat or Barge Canals.

**CANALS, INTEROCEANIC AND INTERNATIONAL,** artificial waterways connecting two open seas. They are likely to have such general commercial and strategic importance as to suggest some form of international agreement governing their use. The SUEZ CANAL, by international convention, is open to all nations. The PANAMA CANAL is open to the commerce of all nations, although the United States has practically complete control, and alone pos-

sesses the right and responsibility of fortification and military protection.

**CANANDAIGUA**, a city in western New York, the county seat of Ontario Co., situated on Lake Canandaigua, 28 mi. southeast of Rochester. It is served by bus lines and two railroads. Diversified farming is carried on in this district. The local factories produce enamel, tin, corsets, and canned vegetables and fruits. A psychiatric hospital for Veterans is located here. Canandaigua is a summer resort in the Finger Lakes region. Nearby is Squaw Island State Park. Pop. 1920, 7,299; 1930, 7,541.

**CANANEA**, a mining town in northern Mexico, situated in the state of Sonora, about 35 mi. south of Douglas, Arizona. It is one of the most important mining centers in the Republic and has extensive mines and smelters. The output of the mines is said to be about 3,000 tons of ore daily, and in good times the payroll amounts to half a million dollars a month. Thousands of men, Americans and native workmen, are employed. To the south lies "Old Cananea," an interesting Indian village. Pop. 1930, 16,218.

**CANARESE** (Kannada, Karnata), a **DRavidian** language spoken by about 10,000,000 persons in Mysore, and in some adjoining portions of the Madras and southern Bombay presidencies and of western Hyderabad, though its area formerly extended further north. Its early inscriptions, the first dated about 500 A.D., are the oldest records in any Dravidian language. Canarese has undergone successive changes corresponding to the main periods of its literature. Ancient Canarese, answering to the so-called Jaina period, begins with a treatise on poetry written in the 9th century and citing older poets; and to the 10th century belongs Pampa, whose history of the first Tirthankara, or Jaina Messiah, and version of the *Mahābhārata* are still considered unsurpassed in style. The second period exhibits lyrics inspired by the two great Indian religious systems of Ājīvaism and Vaiṣṇavism, while the *Jaiminī Bhārata*, of the 17th century, based on an episode of the horse-sacrifice in the *Mahābhārata*, is the most popular work of all Canarese literature. About this latter date, historical works mark the beginnings of prose and of the modern stage of the language. J. B.

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**CANARY**, a small bird of the finch family, reared for its plumage and song, native to Madeira and the Canary Islands, whence the name. When wild the birds are dull green, darkly streaked, and smaller than domestic canaries. They build nests near houses and live on seeds and insects. Domesticated birds are brightly colored, pure yellow, "cayenne," or streaked with darker hues. Canaries were first domesticated in the 16th century in Italy, and were soon introduced throughout Europe. To-day they are widely raised as cage birds. In the Harz Mountains, the industry is of major importance, almost every cottage being a nursery; in England, Scotland and Belgium, the birds are also raised on a commercial scale.

There are some 27 distinct breeds, usually named for localities: the Norwich being a bird of beautiful plumage and inferior song, the Manchester growing sometimes 8 in. in length, the Scottish Fancy being a slender, curved bird, highly ornamental. A Belgian breed has a curious humped back; Harz Mountain birds, the most famous, are beautiful singers. The canary, even in captivity, is naturally monogamous.



WILD CANARY  
*Serinus canarius*

Young birds are taught to sing by others, in the Tirol being exposed to the song of the nightingale. Canaries, usually prolific, are sometimes crossed with finches or linnets, but the offspring are sterile. Prices of fine canaries may run to \$150 each. In captivity, the birds need good light, warmth, a daily bath and plenty of seed, with cuttlefish for lime. Perches should not be too thick for the bird's feet to grasp them with perfect comfort.

**CANARY GRASS** (*Phalaris arundinacea*), a smooth, erect annual, native to southern Europe and sparingly introduced into the United States. It grows about 2 ft. high, bearing flat leaves and an ovoid flowering head of white spikelets marked with green nerves. The plant is cultivated in Mediterranean countries for its seed, the canary seed of commerce, used as a food for caged birds.

**CANARY ISLANDS**, a Spanish group in the Atlantic Ocean where 15° W. long. crosses 29° N. lat.; about 60 mi. from the northwest coast of Africa, and 2,807 sq. mi. in area. The group consists of Teneriffe, Grand Canary, Ferro, Palma, Gomera, Fuerteventura, Lanzarote and six uninhabited islets. Teneriffe has 184,000 inhabitants, and Grand Canary 165,000.

Like the other West African islands, the Canaries are of volcanic origin. The snow-capped peak of Teneriffe rises to 12,152 ft. This volcano is not extinct, though normally quiescent. Grand Canary contains a remarkable extinct crater, Caldera, a mile in diameter and 1,000 ft. deep, whose highest point reaches 6,000 ft. The islands have few lowlands, and in such regions the rainfall is very small. The west side has more rainfall than the east, but the lower areas, of largely decomposed basalt, bear only scant

vegetation, and streams from the mountains are essential to cultivation. At higher levels are growths of laurel and oak, vegetation ceasing at 10,000 ft. With irrigation, bananas and dates flourish in the lowlands; at the higher levels olives, vines, oranges, tobacco and cereals are carefully cultivated, and large crops of onions, tomatoes and potatoes are produced. The wine industry has declined owing to the rising supremacy of Cuba as a producer, and the red dye obtained from the cochineal insect has lost much of its value since aniline dyes have been on the market. Bullock transport prevails, though camels are also used.

The industries include embroidery, lace and drawn-thread work, cigar- and cigarette-making (tobacco being imported from the Dutch East Indies and the United States), and fishing, which is of increasing importance. Commercially the Canaries may be divided into two groups, each with its market center: Las Palmas, on Grand Canary, in the eastern group, and Santa Cruz, on Tenerife, in the western group. Santa Cruz was made a protected harbor in 1928-32 by the lengthening of its mole to 3,400 ft. It is attaining increasing popularity as a health resort and is the seat of administration of the group. The climate of the islands is generally mild, dry and healthy, but infant mortality is high.

The Canaries were vaguely known in ancient times as the Fortunate Islands, and appear to have been inhabited originally by a race allied to the Berbers. They became Spanish in 1479 and now rank as a province of Spain. Pop. 503,151.

**CANBERRA**, the capital of Australia. In 1911, 940 sq. mi. of New South Wales, 70 mi. inland, between Sydney and Melbourne, were handed over to the Commonwealth to form the Federal Capital Territory. A modern city, called Canberra after the native name of the parish on which the city stands, was laid out on ground plans designed by W. B. Griffin, an American architect. There are Parliament and administrative buildings, dwellings, stores, parks and boulevards.

The first parliamentary session at Canberra was opened by the Duke of York on May 9, 1927. Melbourne was formerly the federal capital. Est. pop. of the Federal Capital District 1930, 8,841.

**CANBY, HENRY SEIDEL** (1878- ), American editor, was born in Wilmington, Del., Sept. 6, 1878. He graduated in 1899 at Yale, where he later taught English, and in 1922 became lecturer with professorial rank. He was assistant editor of the *Yale Review* in 1911-20; editor of the *Literary Review*, of the New York *Evening Post* in 1920-24; and in the latter year became editor of the *Saturday Review of Literature*. His writings include critical essays and studies on literature and education.

**CANCER** (gen. *Cancrī*), the crab, the fourth constellation of the Zodiac visible in late winter and spring. It contains only stars of the fourth magnitude and fainter, and the interesting star cluster Praesepe, the manger, comprising numerous stars be-

tween the sixth and tenth magnitude. The fifth magnitude star Zeta Cancrī is an interesting triple star. Some 2,000 to 3,000 years ago, the sun stood in the constellation Cancer on the longest day in the year on the northern hemisphere. For this reason the line on earth parallel to the equator where the sun stands overhead on that day and which marks the northern limit of the tropical zone is called the tropic of Cancer. See *STAR: map*.

**CANCER.** Cancer is a universal disease which afflicts both human beings and animals. It differs from all other diseases in that it is due solely to a growth of the tissues of the body. Cancer tissue comes from healthy tissues and differs from them only in the quality of being able to grow rapidly and spread around the body. The minute cells of a cancer of the skin, for instance, are exactly the same as the cells which form the healthy skin, and cancer of the bone is composed of bone cells of the same nature as those of the original bone from which they came.

**Causes.** The exact cause of this change is not known. All that is known on the subject is that *chronic irritation* may give rise to cancer in both human beings and animals. One of the best examples of such irritation is that produced by ordinary coal tar. Men who work with coal tar and do not keep their hands clean, may, after a number of years, develop cancer of the skin of the hand. If a mouse is painted with the same sort of tar, a cancer will develop, in the course of a few months, of exactly the same type as one which appears in human beings. The tar irritation makes the cells grow, and ultimately a new race of cells is produced which can grow independently of any bodily control. In many types of human cancer, chronic inflammatory processes precede the cancer. Further than this we do not know.

It is evident that cancer is *not a germ disease* in the ordinary sense of the word, that is, it is not like typhoid fever or pneumonia in which a germ enters the body from without and gives rise to the damage to the system as a result of what we call typhoid or pneumonia. Instead, it is a growth of the body's own cells. From this it is evident also that cancer cannot be contagious, as grafted tissues from one body do not grow well in another person. There are always slight differences. On the other hand, cancer is *not inherited*. But it is possible to inherit tissues which are sensitive to irritation, just as certain malformations of the tissues are inherited, such as harelip, or certain peculiarities of the blood, like that of bleeders, can be transmitted. But it is only the susceptibility and not the disease itself in the case of cancer. In human cancer inheritance probably plays a very small part.

**Spread.** While cancer at first is local, it has a tendency in many varieties to grow into the smaller blood vessels and lymphatic drainage channels and thus work its way around the body. Each little group of cells becomes a new focus of cancer of the same sort as the original growth and it is easy to see that when such metastasis occurs treatment by removal is impossible.

**Varieties.** There are many kinds of cancer, corresponding to the numerous types of tissue in the body, and each has its own peculiarities. Cancer of the liver resembles liver cells; cancer of the thyroid resembles thyroid cells, and so on. For cancer of the bladder, stomach and mouth, *see* BLADDER, URINARY; DYSPESIA; MOUTH, DISEASES OF.

**Occurrence.** Cancer occurs at *all ages*, but it is most frequent in old people, and is very rare in young children. This is probably due to the fact that the irritations which cause cancer take a long time to effect the change in the cells. Thus in man it takes six or eight years to produce a tar cancer.

**Sex** does not play a part in cancer, except that women have special organs in which cancer is frequent, so that the kinds differ in the two sexes. In some countries women have more cancer than men; in others, men more than women.

All *rac*es are affected by cancer, though again there are differences in distribution. The black races have less cancer of the skin than the white, but they have more of other varieties.

There has been a great interest in the subject of cancer in the last thirty or forty years because of the realization of the fact that it is a very important disease, being responsible for about one-tenth of the deaths which occur from all causes. In fact, at the present moment, it is second to heart disease, which kills more people than any other trouble. As cancer is a disease of age, those countries or states or cities in which there is a large population of advanced age will show the most cancer. For example, states like Vermont and Maine, in which there are a great many old people, have high cancer rates, while some of the Western states, where most of the people are young, have very low rates. There is no definite evidence that cancer is increasing. The Census Bureau records show an increased number of cases, it is true, but this is largely due to the aging of the population of this country, the average being now older than it was twenty or thirty years ago (*see* EXPECTATION OF LIFE) and also to the great improvement in the diagnosis of cancer.

**Diagnosis.** The diagnosis of cancer is extremely difficult, and with the exception of a few forms, such as skin cancers or cancer of the mouth, cannot be diagnosed by the layman, so that a physician should always be consulted the moment anything suspicious is noted, such as a sore that does not heal or any lump that appears to be increasing in size. The internal cancers are the most difficult, obviously, to diagnose, and here the highest professional skill aided by elaborate chemical tests and X-ray pictures may be necessary before, for example, a cancer of the stomach can be definitely diagnosed. It is important for the public to remember that cancer becomes a frequent disease only after the age of 45, and that after that time people should be very careful to have any chronic sore treated immediately, and that any symptoms, such as a bad cough coming on suddenly, or persistent indigestion, or the passage of black

material in the stools, or blood in the urine, should be a signal for immediate consultation with one's physician.

**Treatment.** The treatment of cancer is unfortunately not very effective as yet, because people do not go to the physician soon enough to have a diagnosis made in the early stages of the disease, and because many cancers in the internal organs are entirely inaccessible to treatment. The only effective treatments are those which are to destroy the cancer. The surgeon cuts it out; the radiologist destroys it with radium or X-ray or electric currents, but it can easily be understood that if the cancer has remained in the body so long that it has spread everywhere, or even if only a small amount has spread to an important organ, like the liver or the lung or the bones of the body, it is impossible to produce a cure because we cannot cut out the liver, the lung, or bones like those of the spine. X-ray and radium treatments in capable hands may in many instances, however, greatly prolong life and comfort, and by treating certain types of these incurable cancers, even though they have spread to a considerable distance about the body, people may live for many years. In other types little or nothing can be done, except to make the patient comfortable with the necessary drugs, of which modern chemical science has placed a large number of useful ones in our hands. There is no other way of treating cancer than that above mentioned. No serum or medicine is capable of destroying the cancerous tissues and leaving the healthy tissues undamaged.

Scientists are studying cancer in animals in laboratories all over the world, attempting to produce some serum cure, but so far have failed. There is no reason, however, if this work is continued, why it should not be possible ultimately to produce a serum which will cure cancer, just as a serum cures diphtheria, but that time has not yet come. (*See also* PAUL EHRLICH; TUMORS.)

F. C. Wo.

**CANCER-ROOT**, a name given in the United States to various parasitic plants, destitute of green foliage, belonging to the broom-rape family, especially the squaw-root (*Conopholis americana*), beech-drops (*Epifagus virginiana*) and the one-flowered broom-rape (*Aphyllon uniflorum*).

**CANDELABRUM**, a candlestick, especially one richly decorated in one of the classic styles. More loosely the word is used for a Roman lamp stand, or for any decorative ornament based on the candelabrum shape. This decorative use occurred in Roman frieze decorations, and became a favorite feature in the early Renaissance of north Italy and France, being frequently used not only for elements in friezes and panels, but also for free standing colonnette shafts.

**CANDIA**, officially Herakleion, the largest city in CRETE, situated on the northern coast of the island. Massive fortifications surviving from the time of the Venetian occupancy surround the city. In 1669 the Turks captured the city. Candia has a museum containing antiquities found during recent excavations. Among its chief buildings are 14 mosques, a cathe-

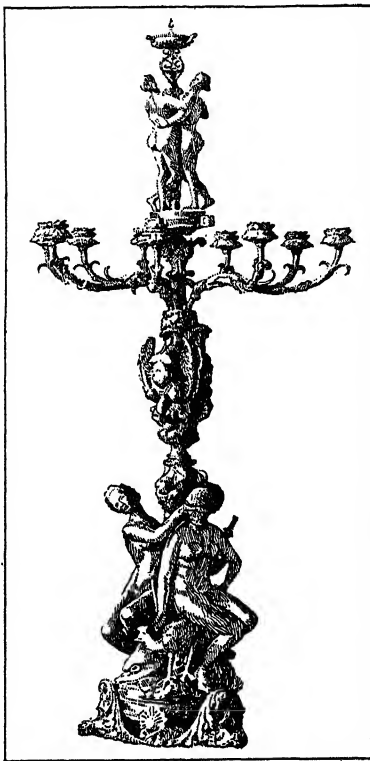


dral, two Greek and one Armenian churches, besides the bazaar, the public baths and the Venetian fountains. The city exports oil, soap, dried raisins, almonds, wine and cocoons. It also is the see of an archbishop. Pop. 1928, 33,404.

**CANDIDA**, an early play and one of the best by GEORGE BERNARD SHAW, written in 1894. This is the drama of the generous-hearted Candida, who is forced to choose between the love of her husband, a good but rather pompous clergyman, and that of a young poet, Marchbanks, who has sufficient fire and imagination to understand her. Though greater in emotional content than are the majority of Shaw's plays, Candida



COURTESY M. M. OF ART  
ROMAN CANDELABRUM OF BRONZE  
25 B.C. to 300 A.D.



COURTESY M. M. OF ART  
FRENCH CANDELABRUM OF THE 19TH  
CENTURY  
Designed by Jean Antoine Barye

moves swiftly, wittily, often satirically, with an abundance of Shavian moral reflections.

**CANDIDE**, the optimistic hero of Voltaire's satirical novel by that name, published 1759. In his countless adventures Candide meets with one misfortune after another, but remains always staunchly optimistic, believing this to be "the best of possible worlds."

**CANDLE BERRY**, a name sometimes applied to the CANDLENUT, widely grown in the tropics, and also to the North American BAYBERRY or wax-myrtle, which yields a wax used in making candles.

**CANDLEFISH** (*Thaleichthys pacificus*), also called eulachon by the Chinook Indians, a sea fish occurring on the Pacific coast of America, from Alaska

to Oregon. A relative of the smelt family (*Argentinidae*), it resembles these fishes, being about a foot long and having an elongate body, somewhat pointed head, and large mouth. The coloring is olive-green on the back, becoming white spotted with yellow on the sides and beneath. During the spring spawning season, candlefish ascend the rivers of Alaska a short way, in great numbers and are caught by the Indians with spiked poles. Their oily flesh makes delicious eating and the oil itself is of some commercial value as a substitute for cod liver oil. The Indians also use them as candles when dried, by passing a wick through them. The coalfish of the Pacific (*Anoplopoma fimbria*) is known as candlefish in San Francisco.

**CANDLEMAS**, a church feast celebrated on Feb. 2. It is known by several other names, notably, the Feast of the Purification of the Virgin Mary and the Feast of the Presentation of Christ in the Temple. In France, following the custom of tossing pancakes while holding a gold coin in the left hand, it is called Pancake Day. In Scotland it shares with Lammass, Martinmas and Whitsuntide the importance of being a Term day, when rents, taxes and interest are paid. Some affirm that it had a pagan origin in the custom of burning candles to the goddess Februa, mother of Mars, whose festival of expiation and purification was held on Feb. 15. In Catholic churches a procession with lighted candles is held, and the candles needed for the altar and other sacred uses during the ensuing year are blessed. Many local customs and traditions have attached themselves to the day, as, for example, the American popular belief regarding the ground hog, whose shadow, seen on this day, portends continued winter.

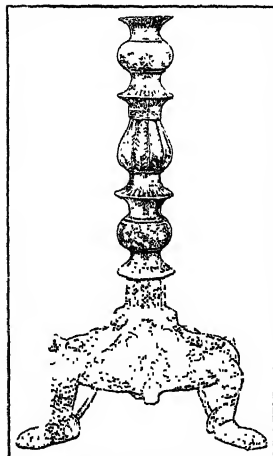
**CANDLENUT** (*Aleurites moluccana*), a large tree of the spurge family with long spreading branches and fleshy fruit containing walnut-like, oil-yielding, edible seeds. The tree is probably native to the Malay region and is widely naturalized in the tropics, where it is grown as a shade tree and for its drying oil which is used in varnishes, in candle-making and for lamp oil.

**CANDLE-POWER**, a unit of light intensity, in terms of which illuminating power is measured. The British standard candle is a spermaceti candle (see WHALE OIL)  $\frac{7}{8}$  in. in diameter, weighing  $\frac{1}{16}$  lb. and burning at the rate of 120 grains per hour. Because of difficulties in reproducing this standard and in maintaining constant illumination with it, it is chiefly of historical interest. For practical measurements, it has been replaced by various secondary standards such as the Harcourt pentane lamp or the Hefner amylacetate lamp, whose ratings under specified conditions are 10 candle-power and 0.09 candle-power respectively. Various electric lamps are also used as secondary standards, their intensity being expressed in candle-power as defined above.

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**CANDLER, ASA G.** (1851-1929), American capitalist, was born near Villa Rica, Ga., Dec. 30, 1851.

After a common school education and a few years' experience as a drug clerk, he entered the drug business in Atlanta in 1878. Soon afterward he bought the formula for Coca Cola, improved it, and in 1892

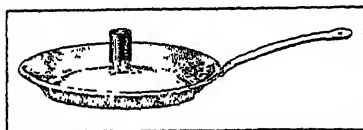


COURTESY M. M. OF ART  
SYRO-EGYPTIAN CANDLESTICK  
OF THE 14TH CENTURY

organized the Coca Cola Company, which he sold in 1919 for \$25,000,000. This was only part of a great fortune which Candler acquired through real estate transactions, cotton warehousing and other investments, and generously expended for civic and educational improvements. Among his large contributions was \$7,000,000 to Emory University at Atlanta. He died at Atlanta, Mar. 12, 1929.

**CANDLESTICKS**, the receptacle for holding a candle, important in domestic and ecclesiastical usage from ancient times.

Solomon's seven-branched candlestick is the earliest known example, and among the Greeks and Romans candles are thought to have preceded oil lamps. As



COURTESY M. M. OF ART  
AMERICAN BRASS CANDLESTICK OF THE  
18TH CENTURY

early as the 8th century large pricket candlesticks were being used in churches. Iron, copper and hardwoods were the chief materials employed before the 17th century, when the Italians experimented successfully in brass. Thereafter gold, silver, Sheffield plate, crystal and china were favored. The 17th century also introduced the saucer-base or bedroom candlestick, which later acquired a tinder-box, extinguisher and glass chimney. The finest examples of tall candlesticks date from the Queen Anne and Georgian periods, when the baluster stem was developed. Their decoration ranges from elaborate floral and mythological treatments to severe architectural motifs. Their designs offer a rich field for present day reproductions.

**CANDLE-WOOD**, the name given to various trees and shrubs, mostly of resinous character, whose finely split wood is used as a substitute for candles, as the rhodeswood (*Amyris balsamifera*), of tropical

America, and the Ocotillo of the southwestern United States.

**CANDOLLE, AUGUSTIN PYRAME DE** (1778-1841), Swiss botanist. After study at Geneva he went to Paris in 1796 and by 1799 produced the first volume of his *Historia Plantarum Succulentarum* which immediately established his position in the botanical world. He took charge of the publication of Lamarck's *Flore Francaise* and in his preface to that work outlined the system of plant classification to the completion of which he devoted much of the rest of his life. De Candolle opposed the then current arbitrary classification of LINNAEUS with a system based upon structural and morphological relationships. From 1806 to 1812 he made a thorough study of the flora of France and was professor of botany at Montpellier (1807-16). In 1816 he became professor of botany at Geneva. De Candolle completed two volumes of his *Regni vegetabilis systems naturalis*, arranging plants therein according to his own system. He was born at Geneva, Switzerland, Feb. 4, 1778 and died there Sept. 9, 1841.

**CANDY**. See CONFECTIONERY.

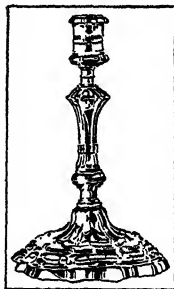
**CANDY**, a city of Ceylon. See KANDY.

**CANDYTUFT**, a genus (*Iberis*) of annual and perennial often somewhat woody plants of the MUSTARD family. There are about 30 species, native to Mediterranean countries, several of which are garden favorites, suitable for beds and borders. Among the most common is the rocket candytuft (*I. amara*), a smooth annual, about a foot high, with white flowers borne in close globular clusters. Several evergreen species are grown as border plants.

**CANE**, the name given in the United States to two large, bamboo-like grasses, both natives of the southern states. The large cane (*Arundinaria macrosperma*), with woody stems, grows 25 to 30 ft. high, forming in alluvial river bottoms dense thickets known as canebrakes. The small cane (*A. tecta*), 3 to 14 ft. high, with somewhat woody stems, grows from Maryland to Missouri and southward.

**CANEA**, also Khania, the capital and principal port of CRETE, situated beautifully on the northern coast of the island. Massive walls, surviving from the days of its Venetian occupation, surround the city. Greek churches, a synagogue, a number of Turkish mosques are found in the city. The harbor, though dredged and protected by a lighthouse, offers no anchorage for large vessels. Oil, soap, wax and leather are the principal articles of trade and export. A mile from Canea is Khalepa, a picturesque hill where the merchants and the European consuls have their residences. Pop. 1928, 26,604.

**CANELLA**, a small highly aromatic tree of the canella family (*Canella alba*), common in the West Indies and southern Florida. It bears leathery leaves, fragrant purple flowers and small black berries. The orange-colored inner bark, known as Canella bark, with a spicy aromatic odor and a bitter pungent taste, used as a spice in the West Indies, is employed in medicine as a tonic.



COURTESY M. M. OF ART  
AMERICAN CANDLE-  
STICK OF THE  
18TH CENTURY

**CANE MILLS**, machines used for crushing sugar cane in the extraction of its juices for the manufacture of molasses and sugar. These mills comprise one or more sets of rollers, usually consisting of two bottom rolls with one top roll operating between them. These rotate at about 2 to 2½ r.p.m. under pressures as high as 500 tons.

**CANE SUGAR.** See SUGAR, CANE; CARBOHYDRATES.

**CANES VENATICI** (gen. *Canum Venaticorum*), the hunting dogs, a small constellation of faint stars directly south of the handle of the Big Dipper. It contains one of the largest spiral nebulae, known as the whirlpool nebulae. See STAR: map.

**CANFIELD, DOROTHY.** See FISHER, DOROTHY CANFIELD.

**CANISIUS COLLEGE**, a Catholic institution founded in Buffalo, N.Y., in 1870 by Jesuit Fathers, and chartered in 1883. It is partly coeducational. The departments include a preparatory school, arts and sciences, teachers' training and extension courses and a summer school. The library contains 27,600 volumes. In 1931-32 the enrollment exclusive of extension students was 603, and the faculty of 45 was headed by Pres. Rudolph Eichhorn.

**CANIS MAJOR** (gen. *Canis Majoris*), the greater dog, an exceedingly brilliant constellation and one of the gems of our winter skies, especially during early evenings in February. Apart from SIRIUS, the Dog Star, the brightest star in the sky, it contains three stars of the second magnitude and numerous stars of the third and fourth magnitudes; many of them are white or bluish and surpass the sun greatly in light-giving power. See STAR: map.

**CANIS MINOR** (gen. *Canis Minoris*), the lesser dog, a small constellation containing the brilliant star PROCYON and little else. Procyon forms an almost equilateral triangle with two other brilliant stars, Betelgeuse and Sirius. It may be found in the south during the early evenings in February and March. See STAR: map.

**CANKER SORES.** See HERPES; MOUTH, DISEASES OF.

**CANKER WORM**, moths belonging to the family *Geometridæ*. Larvæ are slender looping or inch-worm caterpillars, also known as measuring worms. They strip the foliage from fruit and shade trees, being especially fond of elm and apple. They pupate in the soil. Adult moths are brownish gray, the males winged, the females wingless. Eggs are laid in masses on or under the bark of trees upon which the larvæ feed. Two species are recognized, the fall (*Alsophider pomelaria*) and the spring canker worms (*Paleariba vernata*). The former species passes the winter either in the egg or pupa stage; the latter, in the pupa stage. Bands of sticky material fastened around the trunks of shade trees prevent the ascent of the females to lay their eggs. Spraying with arsenicals is the most effective method of control. Canker worm of the Bible was probably something entirely different.

J. R. T.

**CANNA**, the only genus of the canna family, including about 50 species of tall, stately ornamental, unbranched perennial plants with striking foliage and showy, usually red or yellow irregularly formed flowers. Until the closing half of the 19th century cannas were grown more for their foliage or mass effects than for their bloom. About 1860 there appeared a dwarf hybrid race with more showy foliage than the original species. Its varieties have since been used largely for hybridizing with other cannas to originate the modern, large-flowered so-called French or Crozy varieties. During the 20th century another group of varieties has been developed from two American species, *Canna iridiflora* of Peru and *C. flaccida* of Florida and adjacent states. As the initial hybridizing was done in Italy the varieties are often called Italian. Cannas demand rich, loose, moist soil and full sunlight. They are tender and must not be planted outdoors until danger from frost is over. Their rootstocks must be dug after the tops are killed in the fall and stored in dry, frost-proof quarters until spring when the masses of rootstocks may be divided and either started indoors or planted in the garden direct.

M. G. K.

**CANNAE**, an historic village of Apulia in southeastern Italy on the River Aufidus about 1½ mi. from Canusium. Here it was, in 216 B.C., that the Battle of Cannae was fought, the engagement in which Hannibal so overwhelmingly defeated the Romans that the Roman military leaders never again allowed their armies to face him in a pitched battle. Hannibal had under him about 40,000 infantry, which included Spaniards, Gauls and Libyans, and Hasdrubal led 10,000 cavalry. The Roman force consisted of 70,000 or 80,000 infantry and 6,000 horsemen; their leaders were Lucius Aemilius Paulus and Gaius Terentius Varro, who had been elected consuls by the Roman people and hence commanded the army. The Romans went into battle in narrow and deep formation, while Hannibal formed his infantry into a crescent shape, putting his weakest troops, Celts and Iberians, in the center. Consequently, when the Romans pushed through the Carthaginian center they were surrounded, attacked on both wings and almost annihilated. Hasdrubal easily cut down the Roman horsemen under Varro and turned to attack the infantry. Paulus and many of Rome's chief citizens, 80 of senatorial rank, 70,000 in all, were slain, while Hannibal lost 6,000 men. Varro fled to Venusia with 70 followers. The 10,000 Romans who stayed in camp surrendered, and Hannibal marched to Capua.

**CANNAN, EDWIN** (1861- ), English economist, was born 1861. He lectured at the London School of Economics from 1897 to 1926, and was appointed professor of political economy at the University of London in 1907. He is the author of *History of the Theories of Production and Distribution* and *A Review of Economic Theory*, and edited Adam Smith's *Wealth of Nations*. His principal contribution to economics is a modern application of Adam Smith's theory of supply and demand.

**CANNAN, GILBERT** (1884- ), English novelist and dramatist, was born in 1884 at Manchester, and educated at King's College, Cambridge. He served as dramatic critic on the *Star* in 1909-10 and subsequently devoted himself to independent writing. Cannan's works include a translation of Romain Rolland's *Jean-Christophe*, 1910-13, *Everybody's Husband*, *The Anatomy of Society*, *Time and Eternity*, *Seven Plays*, *The House of Prophecy* and *The Release of the Soul*, 1920.

**CANNED BEEF.** See BEEF, CANNED.

**CANNEL COAL**, usually considered a non-coking, bituminous COAL, properly a member of a special group known as hydrogenous, gas, or sapropelic coals, characterized by their high content of volatile oils and gases. Bog-head coals and torbanite are also members of this class. Cannel consists chiefly of spores of plants, or canneloid, which collected in open water, and often forms lenses in other types of coals. Because of its high content of spores, or KEROGEN material, it is a connecting link between coal and OIL SHALE. Easily ignited with a match, it is sometimes called candle coal. Parrot coal is a form which crackles when burning, and horn coal emits a smell of burning horn. See also JET.

**CANNES**, a fashionable winter resort on the French Riviera, department of Alpes Maritimes, about 20 mi. southwest of Nice. It lies opposite the Îles des Lérins, on one of which the Man in the Iron Mask was confined in the 17th century. Napoleon landed near Cannes on his escape from Elba, Mar. 1, 1815. Olives, grapes, fruits and flowers for perfumes are grown in the vicinity. Pop. 1931, 47,259.

**CANNIBALISM**, or the eating of human flesh, has existed from the earliest times and still exists, or did until recently, in Africa, Melanesia, Polynesia and Australia and, to a lesser extent, in Sumatra, the East Indies and the Americas. The motives behind it are not always the same. Cannibalism for food was practised in Africa. In Australia and Melanesia, dead kinsfolk were sometimes eaten as a form of respect. The Australians ate slain enemies to absorb their brave qualities, just as the American Indians sometimes ate the hearts of their foes. The Eskimo ate the hearts of witches to protect themselves against their sorcery and the ancient Mexicans, after sacrificing a human captive to the gods, sometimes ate the flesh as a religious rite.

**CANNING, GEORGE** (1770-1827), British statesman, was born in London, Apr. 11, 1770, and was only a year old when his father died, his mother being forced to earn her living on the stage. When he was eight years old, his uncle, a wealthy banker, offered to take charge of his education. He was sent to Eton and Oxford. Under the advice of Burke and the sponsorship of Pitt, he entered political life in 1793. He upheld the abolition of the slave trade and opposed making peace with the French Directory. In 1804 he was appointed treasurer of the navy; in 1807 he became minister for foreign affairs. He displayed conspicuous ability in this post, being responsible for

the expedition which seized the Danish fleet at Copenhagen and thus frustrating Napoleon's northern confederacy. In 1820 he was appointed governor-general of India and was on the point of leaving England when the suicide of Castlereagh, his former enemy, placed him once more in charge of foreign affairs. He brought about the recognition by the English government of the Latin American countries in their revolt against Spain and Portugal, and prevented England from becoming enmeshed in the Holy Alliance. He also gave vigorous support to Catholic emancipation. In 1827 Canning became prime minister, but his health was failing and he died Aug. 8 of the same year. He was buried in Westminster Abbey.

**CANNING AND PRESERVING INDUSTRIES, UNITED STATES.** In the Census of Manufactures these industries are classified in two groups: (1) those devoted to canning and preserving fruits and vegetables, pickles, jellies, preserves and sauces; and (2) those engaged in canning and curing fish, crabs, shrimps, oysters and clams. To the total output produced in 1929, valued at \$831,190,554, the first group contributed \$750,342,041 or 90.3% and the second group \$80,848,513 or 9.7%. The rapid development of these important industries during the 30-year period ending with 1929 is shown in the following table.

CANNING AND PRESERVING, U.S., 1899-1929

Year	Vo. Estab- lishments	Wage Earners	Wages \$	Value of Products \$
1899.	2,570	57,012	13,705,105	99,335,464
1909..	3,767	59,968	19,081,843	157,101,201
1919 .	4,280	89,923	66,444,023	628,287,925
1929..	3,345	112,478	83,777,648	831,190,554

**CANNON, JOSEPH GURNEY** (1836-1926), American statesman, was born at Guilford, N.C., May 7, 1836. He studied law in a lawyer's office and for six months at the Cincinnati Law School before beginning to practice in Shelbyville, Ill., in 1858, later moving to Danville, Ill. As a Republican, he was state's attorney for the 27th judicial district, 1861-68. Defeated as a Republican candidate for Congress in 1870, he was elected in 1872 and served in the House until 1891, the Democratic landslide of the previous year turning him out of office. His unconventional manners and conversation caused him to be known popularly as "Uncle Joe." He was returned to Congress in 1893 and served until 1913, acting as Speaker of the House for 10 years (1901-11) in a dictatorial manner which came to be known as "Cannonism." He exercised his power of committee appointments to control the order of procedure and in the chair he generally recognized those whose expected remarks were acceptable to him. In 1909 an unsuccessful attempt was made to break his power, but in 1910 a coalition of Democrats and insurgent Republicans ended his arbitrary régime by passing a resolution whereby the Committee on Rules was elected by the House and the Speaker made ineligible for membership on it. Defeated for reelection in

1912, he again sat in Congress, 1915-23, retiring in the latter year. During his long career in the House, his record was one of consistent opposition to constructive and progressive legislation, but he was, nevertheless, a generally popular figure. He died at Danville, Ill., Nov. 26, 1926. S. McK.

**CANNON.** See ARTILLERY.

**CANNON-BALL TREE** (*Couroupita guianensis*), a tall soft-wooded tree of the lecythis family, native to Guiana and occasionally cultivated for its odd appearance. Borne on the trunk and larger branches are large clusters, 2 to 3 ft. long, of very showy flowers, yellow and red on the outside and crimson-lilac within. The reddish ball-like fruits, 6 to 8 in. in diameter, have hard woody rinds, which are sometimes used for making utensils.

**CANOEING**, a water sport especially popular in the United States and Canada. In England the sailing canoes with full or part deck is favored; but in America the open canoe modeled on that of the Indians is preferred. A canoe should move smoothly and silently, without splashing. While a canoe will carry surprising loads, if well distributed, the average 17-foot craft travels best with three persons. If capsized, an overturned canoe will support several people indefinitely. With two paddlers, one kneels in the bow; the other, who steers, in the stern. They paddle on opposite sides. A single paddler usually kneels just in front of the rear thwart. He may dip his paddle alternately on each side or may paddle from one, steering by a sidewise and outward curve of the paddle at the completion of each stroke. The paddle, held at right angles to the canoe, is grasped by one hand at the widened butt, the other gripping just above the blade. In rough water, waves should be quartered, or crossed obliquely. Crossing head-on strains the canoe, and the trough of the waves is dangerous. True Indian ability to shoot rapids without shipping water is possessed by many experts. See also BOAT.

See C. B. Vaux, *Canoe Handling*, 1888.

**CANON**, in music, the name of a composition in which a number of voices repeat the same theme at given periods after the first announcement of the melody. In the early English form, the first voice completed its theme before the repetition set in and then continued the air as an accompaniment. This was called a "round" and it is still popular in England. In its more classical form the entrances of the theme may occur before the completion of its preceding announcement.

**CANON, SECULAR**, a clergyman belonging to a cathedral or collegiate church. In early times the canons maintained a common life together with the bishop and took no vows, but lived according to prescribed rules. The bonds of the common life relaxed, however, and the revenues were divided among the bishop and the clergy. This laxity brought about the development of the canons regular, priests bound by vows of religion and living under strict rules. Though much like monks, they differ in that they undertake active works and always take Holy Orders.

In the Church of England the canons are now permitted to marry.

**CANON CITY**, a city of central Colorado, the county seat of Fremont Co., on the Arkansas River at the entrance to the Royal Gorge, 44 mi. northwest of Pueblo, served by two railroads. There is an airport. Canon City is the home of the world's highest bridge, spanning the Royal Gorge, 1,053 ft. above the rushing water of the Arkansas River, and also of the steepest incline railway, climbing one side of the cañon, 1,550 ft. long. There is also a hanging bridge at the base of the Gorge. There are mineral springs in the vicinity, and the city's swimming pool is fed by hot artesian wells. Oil and coal are found in this region. Fruit growing and truck farming are the leading agricultural interests of the picturesque Arkansas valley. Canon City was settled by Anson Rudd in 1862 and incorporated in 1872. Pop. 1920, 4,551; 1930, 5,938.

**CANONESS**, a woman who receives a prebend (see PREBENDARY) and lodges in a religious foundation. The canonesses, mostly of noble birth, have rules similar to canons regular. Some of the foundations became Protestant after the Reformation.

**CANONICAL HOURS**, see HOURS, CANONICAL.

**CANONIZATION**, a term sometimes used in reference to the inclusion of a book in the Bible canon, but more commonly referring to the final process and decree by which the Roman Catholic Church places the name of a deceased person in the list or canon of the saints. It is a precept of the Roman pontiff which commands public veneration to be paid to an individual by the Universal Church, and is a decree which most Catholic theologians hold to be infallible. Although some authors trace the origin of canonization to pagan apotheosis, Catholic writers find that it is based on the Church's doctrine of the communion of the saints.

**CANON LAW.** The public law of the Western Church has as its sources the Scriptures, Catholic tradition, decrees of ecumenical and other councils, official pronouncements of popes, and the opinions of canonists. The first period in the development of canon law closed with Gratian, a Bolognese monk who in the middle of the 12th century published his "concordance of discordant canons," known as the *Decretum*, which came to be widely used in universities and Church courts. Important additions were made by Innocent III and by the third and fourth Lateran Councils, 1179 and 1215. The first official collection was published under Gregory IX in 1234; and at the close of the 13th century Boniface VIII ordered a codification of the canons and decretals issued since 1234. The second period covered the years between Gratian and the Council of Trent in the 16th century; the years since Trent form the third period. Gratian's arrangement of his material, despite its value, proved unsatisfactory, and, until the codification made in the present century, under Pius X and Benedict XV, compilations of the canon law followed the illogical but convenient order "judex, judicium, clerus,



connubia, crimen." Many of the rules and principles of the canon law are derived from the Roman law; but the canon law has shown a greater flexibility, as it has been tempered by privileges and dispensations, and, during the first period, local custom was allowed, in the interest of equity, to override legislative enactment. Scientific in content and characterized by logical consistency, the canon law was an important factor in medieval civilization and still possesses significance as the ecclesiastical law of the Roman Catholic Church to-day. A special school for the study of canon law was founded by the Holy See in 1923 at the Catholic University of America. A. H. S.

**CANONSBURG**, a borough of Washington Co., southwestern Pennsylvania. It is situated 17 mi. southwest of Pittsburgh and is served by the Pennsylvania Railroad. The city is surrounded by good farming country. The chief local manufactures include steel and tin products and pottery goods. In 1929 the industrial products were approximately valued at \$21,000,000; the retail trade reached \$5,932,780. There are coal fields and gas wells in the vicinity. In 1911 South Canonsburg was consolidated with Canonsburg. It was the center of opinion and action during the Whiskey Rebellion in 1794. Pop. 1920, 10,632; 1930, 12,558.

**CANOPUS** (*Alpha Carinae*), the brightest star of the constellation CARINA and the second brightest star in the sky. It was named after the navigator of Menelaus who piloted the Greek battlefleet home after the destruction of Troy. Its distance has not yet been accurately determined, but must surpass 100 light years. It follows that the star is at least 2,000 times brighter than the sun. See STAR: map.

**CANOVA, ANTONIO** (1757-1822), Italian sculptor, was born at Passagno, in the Venetian Alps, Nov. 1, 1757, the son of a sculptor. In Venice he studied with Torretto and executed a group, *Orpheus and Eurydice*, which showed great skill. Canova went to Rome in 1780. Here his heroic sized *Theseus Vanquishing the Minotaur* established him as the champion of the classic revival, and his fortune was made with the tomb monuments of Clement XIII and XIV, and that of the archduchess Maria Christina, at Vienna. In 1802 Canova was called to Paris where he executed a large bust of Napoleon, and in 1815 he returned to recover the art treasures which had been removed from Rome by the French. Canova was the most popular sculptor of his day; but his pseudo-classic renditions of Cupid and Psyche and the goddess Hebe are now considered as second-rate and artificial as the Baroque art they replaced. He died at Venice, Oct. 13, 1822.

**CANTABILE**, a term in musical EXPRESSION indicating a singing manner, being derived from the Italian *canto*, a song or melody.

**CANTABRIAN MOUNTAINS**, a mountain range of northern Spain, situated near the coast below the Bay of Biscay. They stretch for more than 300 mi. from the western extremity of the Pyrenees to Cape Finisterre. The chain attains its greatest

height in the center, where Peña Vieja reaches about 8,700 ft., and where the headwaters of the Ebro River rise. The most important pass is the Puerto de Pajares. The north and west slopes descend in an abrupt declivity, while the south and east merge gradually with the plateau. The mountains, for which there are many local names, are traversed by railway routes and good roads. Rich iron and coal deposits are found there.

**CANTALOUPE**, a variety of MUSKMELON with hard, often rough or furrowed rinds named from Cantaluppi, Italy, where this melon, derived from southwest Asian stock, has long been cultivated. In North America the name cantaloupe is widely, though incorrectly, applied to all muskmelons.

**CANTATA**, a composition for chorus and solo voices, usually of sacred character and furnished with organ accompaniment. It is longer and more diversified than the MOTET, shorter and less ambitious than the ORATORIO. Originally the name was applied to any composition for voices.

**CANTERBURY**, a city and a parliamentary and county borough of England, in Kent, England, 62 mi. southeast of London. It is situated on the river Stour at the head of a beautiful valley of the North Downs across which ran the Pilgrim's Way followed by Chaucer and his company. Canterbury was the Roman-British *Durovernum* flourishing at a junction of roads from Kentish ports to London. In 597, after converting the Saxon King Aethelbert to Christianity, St. Augustine established himself in Canterbury as first archbishop. The famous cathedral, originally his undertaking, was repeatedly gutted by fire and rebuilt during the Norman and subsequent eras, and is today a magnificent blending of Norman and Perpendicular styles. Thomas à Becket was murdered in its glorious choir, 1170, and his rich shrine was a focal point for pilgrims until dismantled by Henry VIII in 1538. Scattered among the fine monastic remains of Canterbury is some Roman material, and the old city walls are traceable. In addition to its ecclesiastical interests as the seat of the Primate of the Church of England, Canterbury has tanneries, brickworks, and a considerable agricultural trade. Pop. 1921, 23,737; 1931, 24,450.

**CANTERBURY CATHEDRAL**, Canterbury, England, generally considered the most important cathedral in England; and since THOMAS À BECKET was murdered before its altar in 1170, the center of the nation's ecclesiastical life. The archbishopric has been the first in the country since the time of Archbishop Theodore, 668-93. From the archiepiscopate of Dunstan, 960-88, until the overthrow of James II in 1688, the Archbishop of Canterbury exercised great political and ecclesiastical power.

The first cathedral of which any part is still standing was begun in 1070 by Bishop Lanfranc, was continued by his successor, Bishop Anselm, and the priors Ernulph and Conrad, and was finished in 1130. It was in this Norman church that Becket was murdered. In 1174 the choir burned down, and the

Frenchman, William of Sens, was employed to rebuild it. French Gothic, it is generally acknowledged, was thus introduced into England.

Between 1378 and 1410 the Norman nave and transepts were replaced by the present structure in the Perpendicular style. The stately central tower or "Bell Harry Tower" was raised in 1495-1503 to a height of 235 ft. on its original Norman foundations.

Canterbury possesses a wealth of fine detail, but its chief treasure is its beautiful old glass, second in England only to that of York and dating chiefly from the 13th century. The magnificent Trinity Chapel, behind which is the corona, occupies the site of Becket's shrine, destroyed by Henry VIII in 1538. The saint's martyrdom took place in what is now the northwest transept, on a spot indicated by a marker. Henry IV and the Black Prince are buried in the cathedral, as are the noted archbishops, Stephen Langton, Stratford, Chichele and others, among them the last Roman Catholic archbishop, Cardinal Pole. Of St. Dunstan's shrine only a few relics remain.

**CANTERBURY TALES, THE**, a collection of 24 stories in Middle English verse by GEOFFREY CHAUCER, written late in the 14th century. The plan of the *Canterbury Tales* is set forth in a magnificent Prologue which briefly introduces 29 pilgrims who, on their way to the shrine of Thomas Becket at Canterbury, have assembled at the Tabard Inn, Southwark, London. The pilgrims include a knight, a monk, a priest, a scholar, a friar, a merchant, a steward, a doctor, a miller and other notable types of the 14th century; each one is so deftly characterized that he or she lives both as an individual of the period and as an eternal human type. It is agreed that each member of this varied band shall tell two tales as they ride to and from Canterbury, the Knight being chosen to tell the first. Every tale has been contrived by the poet to be interesting in itself and also to reveal the precise character of the one who tells it. Each tale strikes a different note, whether earthly or spiritual, sad or humorous, according to the narrator. The most noted tales are those told by the Knight, the Nun's Priest, the Clerk, the Wife of Bath, the Reeve and the Pardoner. *The Canterbury Tales* are unique in English literature, as fiction, as a record of customs and manners, and as fresh and sparkling poetry.

**BIBLIOGRAPHY.**—Standard edition by W. W. Skeat, 1897, new ed. 1929; T. R. Lounsbury, *Studies in Chaucer*, 1892; G. L. Kittredge, *Chaucer and his Poetry*, 1915; J. L. Manly, *Some New Light on Chaucer*, 1926.

**CANTILEVER**, a beam supported at one end, a load being applied at the extreme free end or distributed evenly along the entire beam. The upper fibers of the cantilever beam are subjected to a tensile stress and the lower fibers to a compressive stress. Cantilever construction is used where it is undesirable or impossible to place a supporting member under the outer end of a beam, as in bridges, cranes and projecting portions of buildings. *See also* CANTILEVER BRIDGE; MECHANICS.

**CANTILEVER BRIDGE**, one in which long arms project part of the way from opposite shores, and suspend a simple TRUSS bridge. These projecting arms are anchored to "shore" arms, fixed anchor spans or anchorage, and form continuous spans, having their points of flexure definitely fixed by the hinged connections. Because of its simplicity of construction, this type of bridge is suitable for fairly long spans; it also has advantages in localities where a falsework cannot easily be erected. *See also* BRIDGES.

**CANTO FERMO**, the Italian form of the Latin *cantus firmus*, literally, a firm song, or melody which remains unchanged when other voices move contrapuntally around it. During the early history of the Christian church ecclesiastical music was exclusively sung, and sung in unison. Known at first as Ambrosian chant and later as Gregorian chant, this *cantus planus*, or plain-chant, eventually served as the nucleus about which other secondary melodies gathered as ornaments. To some extent the church combated this movement; the Council of Trent, in fact, was so concerned over the increasingly secular tendency of church music that it considered banishing the entire art from cathedrals. With the advent, however, of PALESTRINA (c. 1525-1594) the possibility of combining counterpoint with reverence was made manifest; and thenceforth the former *cantus planus* was honored in the form of a *cantus firmus* which, while permitting itself to be covered with ornament, stood firm under the buffetings of polyphony. To-day, in secular music, a *canto fermo* has exactly the same meaning, namely, a melody which is retained intact through the course of a composition that is contrapuntal. For the student of musical theory, however, it has also the special meaning of a given air which is assigned successively to four voices while the other three voices weave contrapuntal melodies around it. The discipline thus prevailing is one of the chief concerns of COUNTERPOINT.

**CANTON**, in Switzerland the 22 cantons are the members of the Confederation, corresponding to states in the United States. In France the canton is a judicial and election district; there are 3,019 cantons or an average of one to each 12 COMMUNES.

**BIBLIOGRAPHY.**—R. C. Brooks, *Government and Politics of Switzerland*, 1918. E. M. Sait, *Government and Politics of France*, 1926.

**CANTON**, chief treaty port of southern China, and capital of Kwangtung province. It is situated on the Chu Kiang, or Pearl River, and the Pacific Coast. The whole circuit of the city, including the suburbs, is 10 mi. Canton proper is 6 mi. in circumference and has its foreign concessions, British and French, on the Island of Shameen, formerly a sand bar. Modernized, and rich both from its own trade and the earnings of Cantonese abroad, the city has electric lighting, waterworks and one of the few dockyards in the country.

A thriving city, Canton is renowned for its manufactures of blackwood furniture, ivory ware, jade ornaments and jewelry. Among the Westernized

factories are the arsenal, brick and cement works, paper mills, silk filatures, flour mills, oil concerns and glass and leather factories. The position of Canton on the Pearl River and a network of waterways give the city strategic importance for inland trade as well as foreign relations. Leading exports are tea, silk and silk piece goods, matting, cassia and medicines. Other exports are fireworks, ginger and glassware, much of it for Chinese use, distributed through railroad connections, including the Samshui and Kowloon lines.

The chief importance of Canton in recent years, since the rising of the Nationalist Movement in China, has been its political power. As an advanced city, it has given the revolutionary group some of its most important leaders. By position somewhat independent of Northern China, it has threatened entire severance from the central government and the establishment of a Southern Republic. There were Communistic upheavals in the city in 1929 but these troubles did not decrease its trade growth. Canton is the home of South China Bankers, and has a provincial bank with wealth that makes it one of the leading houses in China.

Ancient stories give Canton the name of City of Rams and City of Genii. Until 110 B.C. it was the capital of the Kingdom of Nan Yueh, which included the present Chinese provinces of Kwangtung and Kwangsi and a part of Tonkin. Canton was the first Chinese port to draw foreign trade. Portuguese adventurers arrived there in 1516, and Arab traders had visited the city centuries before. The Dutch followed the Portuguese and the English arrived in 1637. Great Britain in its war with China threatened Canton with capture in 1841. In the following year the city was technically opened to foreign trade by the Treaty of Nanking; in reality it remained closed until 1857. Pop. 1929, 812,241.

**CANTON**, a city of Fulton Co., Ill., 30 mi. west of Peoria. It has railroad and motor bus facilities, and derives trade from the surrounding region of valuable coal mines, brick clay deposits and agricultural interests, including grain-growing and stock-raising. A plow factory, founded in 1842, is the leading industrial establishment. The retail trade in 1929 amounted to \$6,422,952. Canton was founded in 1825 and incorporated in 1849. Pop. 1920, 10,928; 1930, 11,718.

**CANTON**, a town and village in Norfolk Co., eastern Massachusetts. The village is situated about 14 mi. south of Boston and is served by the New Haven Railroad. It is an industrial community whose products include textiles, fire-alarm devices, fishing lines and patent leather. It is the site of Paul Revere's brass and bell foundry. John Eliot preached to the Indians at the foot of Blue hill. Canton was set off from Stoughton, and incorporated as a town in 1797. The village is the seat of the State Hospital School for Crippled Children. Pop. 1920, 5,945; 1930, 5,816.

**CANTON**, a city in Haywood Co. in western North Carolina situated on the Pigeon River, 18 mi.

west of Asheville, in the Blue Ridge Mountain region. Bus lines and the Murphy division of the Southern Railroad serve the city. Canton lies in a farming and stock-raising region. Paper, wood pulp and lumber are the chief manufactures. The city was incorporated in 1893. Pop. 1920, 2,584; 1930, 5,117.

**CANTON**, a city in northeastern Ohio, the county seat of Stark Co. It is situated 60 mi. southeast of Cleveland on the Lincoln Highway and is served by bus and truck lines and three railroads. There is a private airport. Coal, clay and shale are found in the vicinity. The city is an important manufacturing center for structural steel and other steel products. Brick tile, roller bearings and rubber gloves are other leading manufactures. In 1929 the total factory output was worth about \$153,000,000. The wholesale trade proper in 1929 amounted to \$26,264,864 and the retail trade to \$63,279,899. The city was founded in 1807 and chartered in 1854. President William McKinley lived here and is buried on Monument Hill. Pop. 1920, 87,091; 1930, 104,906.

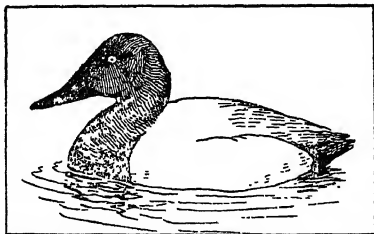
**CANTU, CESARE** (1805-95), Italian historian, novelist and patriot, was born in humble circumstances at Brivio near Milan, Dec. 2, 1805. He turned to teaching and writing to eke out a precarious living but the priesthood would have been his choice. Having espoused the cause of Italian unity under the Papacy, he was arrested by the Austrian authorities in 1833 and imprisoned for 13 months. Here under extraordinary difficulties he composed his famous historical novel *Margherita Pusterla*. The period 1836-43 witnessed the publication of his *Universal History* in 35 volumes. This work and his subsequent writings though of minor importance assured Cantu a substantial place in Italian literature. He died in Milan, Mar. 11, 1895.

**CANUSIUM**, the modern Canosa, a historic city of Italy in Bari delle Puglie in the province of Apulia, situated on the Aufidus River. A Greek colony founded by Diomedes, Canusium came under Roman rule in the 4th century B.C., but revolted against Rome in the Social War. One and one-half miles northeast of Canusium is the battlefield of Cannae, 216 B.C., and it was in this city that the remnants of the Roman army took refuge.

**CANUTE** (c. 994-1035), a king of Denmark and the conqueror of England, was born about 994, the son of Sweyn, king of Denmark. Upon the death of his father in 1014, he became king of England and rapidly gained the good will of his subjects by his discretion and humanity. Later in his career he gained control of Denmark and Norway, and became one of the most powerful rulers of his time. Of him is told the famous legend. Wishing to rebuke his fawning courtiers, Canute ordered the sea to move no farther up the shore. While the tide advanced in spite of his command, the king indicated that his power was nothing in comparison with the Almighty's. Canute died in 1035.

**CANVASBACK** (*Nyroca valisineria*), a highly prized North American diving duck especially es-

teemed by epicures. It closely resembles its near relative the REDHEAD, but differs in its greater size, white back, larger bill and more sloping profile. This duck ranges practically throughout the continent, but breeds only in the interior from Nevada to Minnesota and northward. Formerly, the canvasback was very abundant in the bays and marshes along the coast from Maryland to North Carolina, but over-shooting has greatly reduced its numbers in that region. The ex-



DRAWING BY GEORGE MIKSCH SUTTON

CANVASBACK

cellent flavor of its flesh is attributed to the wild celery (*Vallisneria spiralis*) which forms an important part of its diet. The canvasback builds a bulky nest over shallow water, well concealed among the reeds, and lays 6 to 10 greenish gray eggs.

**CANYON**, a common term in the southwestern United States for the precipitous river-gorges characteristic of an arid plateau region. The Grand Canyon of the Colorado, in Arizona, is the largest, and scenically the most imposing in the world. Here a rapid stream of large volume carves its way for three hundred miles through an immense thickness of rock. Above its bed rise cliffs 3,000 to 5,000 ft. high, here precipitous, there sculptured into terraced "set-backs," fantastic minarets, or spurs, and everywhere banded with strata of vivid contrasting colors. In places the canyon measures ten miles from rim to rim. See also GORGE.

**CANYON DE CHELLY**, a national monument in northeastern Arizona, established April 1, 1931, under the administration of the National Park Service. Great walls of red sandstone within the monument area rise to heights of 700 and 1000 feet and ancient cliff dwellings in caves and crevasses show cultural progress covering a greater period of time than has been revealed in any other ruins thus far discovered in the Southwest. Other outstanding physiographic features include a 20 mile box canyon cut in the red sandstone. The monument, which has an area of 83,840 acres, is reached from Gallup, New Mexico, on the Santa Fe System and the National Park-to-Park Highway.

**CANYON WREN** (*Catherpes mexicanus conspersus*), a small bird found in the Great Basin and Rocky Mountain region southward to central Mexico. It is somewhat larger than the house wren, brown in color except for the white throat and breast, and speckled above with white and blackish markings. This wren frequents canyons and gorges, building thick-walled, moss-covered nests in crevices or on

rock ledges nearly throughout its range and laying usually 3 to 5 spotted eggs. Because of its long ringing song it is sometimes called the bugler wren. See also WREN.

**CAOUTCHOUC.** See RUBBER.

**CAPACITANCE**, in electrostatics, the ratio of an electrical charge,  $Q$ , carried by an isolated CONDUCTOR or CONDENSER to the resulting potential,  $E$ , expressed as  $Q/E$ . The term capacitance is preferred to *capacity* because in structure it accords closely with the terms RESISTANCE, REACTANCE and IMPEDANCE, other properties of the electric circuit with which it is commonly associated. The unit of capacitance is the *farad*, but it is too large to be practical and its subdivisions, the microfarad and the micro-microfarad, are used. These are, respectively, one-millionth and one-million-millionth of a farad.

When a condenser is connected to a battery, the plates of the condenser become charged. The effect of the battery is to draw electrons from one plate and deliver a similar quantity to the other. This transfer of electrons will continue until the rising potential difference between the plates of the condenser is equal to that of the battery, which it opposes. At this point, the flow of electrons ceases, and the condenser is *charged*. The amount of electricity transferred in the operation depends upon the electromotive force of the battery and the capacity of the condenser. If two condensers are connected in parallel to the same battery, the ratio of the charges they acquire is determined by the ratio of their capacities. When a condenser is subjected to unit potential difference, the charge it acquires is numerically equal to its capacity. The capacity of a condenser depends upon the size of its plates and the nature and thickness of the insulating material (see DIELECTRIC) between them.

Two conductors of any sort constitute a condenser when separated by insulating material. Thus, a TELEPHONE wire supported by glass insulators on poles forms, with the earth or with a similar parallel wire, a condenser, the air between them constituting the insulating medium. The capacity of such a wire depends upon its length, its diameter and its distance from ground; the capacity of parallel wires depends upon their diameters and distance apart. A submarine cable has relatively large capacity. It is, in fact, a condenser, the metal core being one plate, the lead sheath the other and the insulating material covering the core the dielectric. The capacity of such a cable depends upon its length, the size of its core and the thickness and nature of its insulating materials.

L. B. S.

**CAPACITORS**, static CONDENSERS, usually designed for improving the POWER FACTOR in alternating current systems. Most commercial apparatus takes a *lagging* current while capacitors take a *leading* current. When capacitors are added to a system, the leading current of the capacitor neutralizes the lagging current of the commercial apparatus giving a power factor of more nearly unity. A common form is made of tin foil insulated by oil-impregnated paper and

sealed in metal containers. In "air" capacitors the plates are sealed in a tank of compressed NITROGEN.

C. L. D.

**CAP-DE-LA-MADELEINE**, city of Champlain Co., Quebec, Canada, situated on the St. Maurice River, about 81 mi. southwest of the city of Quebec. The Shawinigan Falls hydro-power development supplies the local paper, cotton and silk mills, and other smaller manufactures. A French-Canadian city, Cap-de-la-Madeleine contains the oldest Catholic church in the province and the most celebrated shrine of the same faith. As an early trading post it was granted to M. l'Abbé de la Madeleine by Louis XIV. Incorporated as a town in 1918, in 1922 it became a city. Pop. 1921, 6,738; 1931, 8,738.

**CAPE ANN**, a promontory forming the eastern part of Essex Co., Mass., 31 mi. northeast of Boston. On the promontory are the cities and summer resorts of Gloucester, Annisquam, Rockport and Pigeon Cove.

**CAPE BRETON ISLAND**, an island situated south of the main entrance of the Gulf of St. Lawrence, and separated from Nova Scotia by the Strait of Canso. The Canadian National Railroad connects the two by means of a rail ferry. Cape Breton is 110 mi. long, with an extreme breadth of 87 mi. and an area of 3,120 sq. mi. From the northeast the sea extends through two natural channels into the center of the island, where a large salt water lake, the Bras d'Or, is found; at the south the St. Peters Ship Canal connects the lake with the sea. Wooded mountains encircle this lake and give the region a rare and picturesque charm.

Once a separate colony, Cape Breton Island is now incorporated with Nova Scotia. The inhabitants of the island are Highland Scotch; there are some French who are descendants of the Acadian exiles. The wealth of the region is in fisheries, lumber and deposits of marble, limestone, slate and coal. Large quantities of coal are mined near Sydney, the chief city and harbor. Pop. about 130,000.

**CAPE CHARLES**, the southern extremity of the peninsula which forms the eastern shore of Chesapeake Bay, Virginia. It is at the southern point of Northampton Co., about 25 mi. northeast of Norfolk. A first-order flashing white light is situated on Smith Island, to the northeast. Cape Charles village is the terminus of the New York, Philadelphia & Norfolk railroad.

**CAPE COD**, a long, narrow, sickle-shaped sandy peninsula, the southeastern corner of Massachusetts, constituting Barnstable Co. It is situated on the Atlantic coast between Nantucket Sound on the south and Cape Cod Bay on the north, with a length of about 65 mi. and a maximum width of 10 mi. A division of the New York, New Haven and Hartford Railroad serves the cape, while the Cape Cod Canal, 8 mi. long, which connects Cape Cod Bay with Buzzards Bay, an inlet of Long Island Sound, reduces the distance for water-borne traffic from New York to Boston by more than 75 mi. The cape is a popular summer resort.

**CAPE COD CANAL**, a sea level waterway on the coast of Massachusetts, extending from Buzzards Bay to a point on Cape Cod Bay about 15 mi. southeast of Plymouth harbor. It cuts off the peninsula of Barnstable, Mass., and reduces the distance by water from New York to Boston by more than 75 mi. The canal proper is 7.6 mi. long with approach channels of 4.5 mi. in Buzzards Bay and 0.5 mi. in Cape Cod Bay. Its controlling width is 100 ft. Because of strong tidal currents it is not safe for steamers drawing over 20 ft. The canal was completed in 1914 by private capital after five years of construction work. It began to operate under a toll system, but in 1928 was purchased by the U.S. Government for \$11,500,000. Since then the canal has been operated toll free, an arrangement which has greatly increased its use. In 1929 the cargoes passing through it amounted to 2,165,465 tons, 32% of which was coal and 38% mineral oils.

**CAPE COLONY.** See CAPE OF GOOD HOPE; AFRICA.

**CAPE FEAR**, a promontory jutting into the Atlantic Ocean from the southern extremity of Smith's Island, at the mouth of the Cape Fear River. A lighthouse is located on the cape, which is the most southeastern point in North Carolina. The treacherous character of the surrounding waters makes navigation dangerous in the vicinity.

**CAPE FEAR RIVER**, a river of North Carolina, formed by the confluence of Deep and Haw rivers at Haywood, Chatham Co., in the Piedmont region. It runs generally southeast and enters the Atlantic Ocean at Cape Fear. Including its headstreams the river measures about 400 mi. and drains 8,310 sq. mi. The Cape Fear is the longest river wholly within the state of North Carolina. The tide reaches 70 mi. from its mouth and it is navigable at all seasons for 120 mi. to Fayetteville, above which it crosses the fall line. Of its tributaries the Northeast Cape Fear and South rivers are the largest. The city of Wilmington is situated near its mouth.

**CAPE GIRARDEAU**, a city in Cape Girardeau Co., southeastern Missouri, situated on the Mississippi River, 130 mi. south of St. Louis. Bus lines, river craft and two railroads afford transportation. Grain and live stock are produced in this district. The city has shoe and tobacco factories and lumber mills. In 1929 the manufactures reached the approximate total of \$14,000,000; the retail trade amounted to \$8,527,425. The natural resources of the region are hardwood timber, marble, iron, silica and white clay. Cape Girardeau was founded by the French about 1793, and was once a military stronghold and trading post of the Spaniards. The city was incorporated in 1843. It is the seat of Southeast Missouri State Teachers College. Pop. 1920, 10,252; 1930, 16,227.

**CAPE HATTERAS**, a peninsula on the Atlantic Ocean side of Hatteras Island, a long narrow island enclosing Pamlico Sound, N.C., on the east. Despite the two beacons shoals make this part of the coast dangerous for navigators in stormy weather.



**CAPE HORN**, also Hoorn, the southernmost point of land of the South American continent; 450 ft. high, it is a steep, barren rock with sharp summits. Cape Horn was discovered in 1616 by the Dutch explorer Willem C. Schouten, who named it after his birthplace, Hoorn, in the Netherlands.

**CAPEK, KAREL** (1890- ), Czech playwright and novelist, was born at Malé Svatonovice, Jan. 9, 1890. In such works as *The Way of the Cross* and *Tales of Torment* there prevails an intimate psychological note that Continental critics have compared to the plays of Dostoevsky. In certain of his romances, such as *Krakatit*, and in his Utopian dramas, of which *R.U.R.* is a good example, Capek has attempted to invoke the "dynamic rhythm of present and future life," as an Italian critic has expressed it. In several of his plays, Karel Capek has collaborated with his brother, Joseph Capek, notably in *The Insect Comedy*, produced in New York City in 1921, as *The World We Live In*. Other of his plays produced in the United States are *R.U.R.*, 1921, *The Makropulos Affair*, 1922, and *Adam the Creator*, 1927.

**CAPELLA** (*Alpha Aurigae*), brightest star of the constellation AURIGA, the second brightest star in the northern hemisphere, and at present the star about which our knowledge is most complete. It consists of two yellow stars 90 and 70 times brighter than the sun, respectively, and 4 and 3 times heavier, revolving around each other in 104 days at an average distance of 80 million miles. A distant, faint, red star, about 30 times fainter than the sun, completes the system, which is 49 light years distant. See STAR: map.

**CAPE MAY**, the southern extremity of New Jersey which forms the north side of the entrance to Delaware Bay. It is about 2 mi. southwest of the city of Cape May. It has a lighthouse equipped with a revolving light which flashes every 30 seconds.

**CAPEN, SAMUEL PAUL** (1878- ), American educator, was born at Somerville, Mass., Mar. 21, 1878. He graduated at Harvard in 1900 and after studying at Leipzig, taught modern languages and educational administration at Clark University until 1914. The next five years he spent at Washington with the United States Bureau of Education. From 1919-22 he was a director of the American Council on Education and a trustee of the American University Union in Europe. Capen is the author of *Opportunities for Foreign Students at Colleges and Universities in the United States and Resources and Standards of Colleges of Arts and Sciences*. In 1922 he became chancellor of the University of Buffalo.

**CAPE OF GOOD HOPE**, or Cape Province or Colony, a province of the UNION OF SOUTH AFRICA, occupying the most southern extremity of the African continent and bounded west, south and east by the Atlantic and Indian oceans, northeast by Natal Basutoland Orange Free State and Transvaal and northwest by Bechuanaland and South-West Africa. Area 276,536 sq. mi. Est. Pop. 1930, Europeans, 739,314. Afrikaans is in the main the language of the farmers; English is spoken in the towns, chief of which are

CAPE TOWN, Port Elizabeth, East London, KIMBERLEY and Uitenhage.

The region consists of ranges of mountains enclosing sheltered and fertile valleys in which the population is concentrated. The rivers are silted along the coast, and there is no good natural harbor. The Orange River forms a great part of the northern boundary.

The climate is closely comparable with that of the Mediterranean. The good rainfall in the southwest and south is limited to a narrow coastal belt, which, however, considerably widens in the east. The dry area of the northwest provides precarious pasturage and is thinly populated. The raising of cattle, sheep, horses and goats is an active industry. Wheat is the principal cereal crop. The sheltered valleys are famous for their fruit orchards and vineyards, and grapes, peaches, apricots, oranges, plums, pears and figs are exported in large quantities. The manufacture of wines and brandies is large and there is a considerable export. Much tobacco is grown in the Stellenbosch and Wellington districts. Mining activity is not very prominent, except in the diamond fields of Kimberley. Timber is scarce except along the coast.

Education is compulsory for children of European extraction. In 1928 there were 138,987 European pupils under school boards and committees, and 185,552 colored children under church and missionary bodies. Primary education is free.

The Cape was the first part of South Africa to be colonized by Europeans. Although the country was first discovered in 1486 by the Portuguese, it was not until 1652 that the Dutch decided to use Table Bay as a supply station for their ships. In 1659 there were many British settlers, and 30 years later French Huguenots arrived. The British took final possession in 1806. A series of Kaffir wars retarded the progress of the colony. In 1910 Cape Colony, as it was then known, was incorporated as Cape of Good Hope, with Transvaal, Orange Free State and Natal, into the federation named the Union of South Africa.

**CAPER-BUSH** (*Capparis spinosa*), a small, spiny, straggling shrub, of the caper family, often growing on rocks and walls and bearing roundish leaves and solitary, axillary white flowers. It is a native of Mediterranean countries, cultivated in mild climates and in greenhouses for ornament and for the flower buds, from which the pickles known as capers are made.

**CAPERCAILLIE** (*Tetrao urogallus*), a very large grouse, widely distributed in pine forests in Europe and Asia. The male, a famous game bird known also as cock-of-the-wood, measures nearly 3 ft. in length and weighs up to 15 lbs. It is dark gray above and greenish and black below. The female, much smaller in size, has barred and mottled brownish plumage. The capercaillie feeds on young pine shoots, which often give the flesh the flavor of turpentine, and also upon berries, grain and insects. To win a mate the male struts about in an excited manner, uttering strange cries, and battling with blind rage if

a rival appears. A slight depression scraped out under a tree serves for a nest, in which are deposited about 12 yellowish, orange-spotted eggs. The capercaillie sometimes mates with the black grouse.

**CAPETIAN DYNASTY, THE**, the first of the three related dynasties of the kings of France, ruled from 987 until the death of Charles IV in 1328. The family rose to power as counts of Paris during the last century of Carolingian rule, and the election of Hugh Capet to the throne in 987 marks as well as any other event the transition from the Frankish Kingdom of Neustria to the Kingdom of France.

The effective power of the early Capetian Kings was confined largely to their ancestral domains as counts of Paris (between Orleans and Paris, hence the Ile de France). But under Philip Augustus (d. 1223) the possessions of the kings of England in the north of France were recovered and brought under direct rule of the French crown, and the process of rooting out intermediate feudal power in the royal domain and encouraging it in that of the great vassals begun. Under Louis IX (d. 1270) Languedoc, which had been overrun in the Albigenian Crusade (*see* FRANCE, HISTORY OF; ALBIGENSES) was brought within the power of the crown and the central administration of the kingdom vastly improved. Under the last of the great Capetian Kings, Philip IV the Fair (d. 1314), a bureaucratic, centralized administration was developed, the power of the Church was curbed, and the first thoroughgoing, though unsuccessful attempt was made to extend French power over Flanders.

In brief the Capetian kings may be said to have built the French kingdom and left it to the Valois and Bourbon dynasties to defend and later extend.

**CAPE-TO-CAIRO RAILWAY**, a project envisioned by the British empire-builder, Cecil Rhodes (1853-1902), to connect Cape Town with Cairo by means of an English-controlled rail line. The fulfillment of such a project naturally required the control by the British of a continuous stretch of territory from northern to southern Africa, a condition which was finally brought about after the World War. The natural and physical features of the terrain, moreover, make a continuous railroad practically impossible, so that a combination route of rail and water transportation had to be planned. The first link in the line was completed when the stretch from Cape Town to Bulawayo was finished in 1897. Progress was fairly rapid, and the southern border of the Belgian Congo was reached by 1909. Work, of course, was also carried on from the north, and by 1930 the line from Cairo reached the southern Sudan. When completed, the Cape-to-Cairo Railway will be 5,700 mi. long, but of this distance about 2,000 mi. will consist of steamer routes on rivers and lakes.

**CAPE TOWN**, the largest city and capital of the province of CAPE OF GOOD HOPE, Union of South Africa, situated on Table Bay. The beautiful suburbs of the town climb the lower slopes of Table Mountain, which usually has a snow-covered summit in

winter. Pop. 1921, 212,997, of which 60% were white. In 1926 the European population was 130,568.

Cape Town is one of the leading ports of Africa. Shelter in Table Bay, where there have been many wrecks in the past, is now provided by a breakwater 3,640 ft. long, recently lengthened by another 1,500 ft. Wharfage is provided with a depth of over 36 ft., and there are a drydock, grain elevator and storage sheds.

The University of Cape Town is located here. Besides being an outstanding intellectual center and pleasure resort the town has a considerable trade. There are railroad car shops, tobacco factories, breweries and distilleries, tanneries and shoe factories. The city is 5,978 mi. by sea from Southampton, England, and 7,814 from New York City.

**CAPE TOWN, UNIVERSITY OF**, the earliest institution of higher learning in South Africa. South African College was founded as a proprietary institution at Cape Town, So. Africa, in 1829, by a group of Cape Town citizens. For about 20 years after its foundation, it was the only educational establishment in South Africa which gave instruction beyond the range of elementary education. Although the institution provided academic rather than collegiate training, it persisted through difficulties and gradually acquired influence. The University of Cape Town was incorporated by an Act of Parliament passed in 1916 which conferred the status of a university on the South African College, and it was formally inaugurated in 1918. Instruction is given in arts, commerce, science, engineering, law, medicine, education, music and fine arts. The Botany and Zoological departments are especially well-equipped. The university moved to its new site at Groote Schnur, Rondebosch, in 1929. The total assets of the university are £2,243,615. The library contains 30,000 volumes. In 1930 there were 1,892 full-time students and a faculty of 215 headed by Sir J. Carruthers Beattie.

**CAPE VERDE ISLANDS**, a group of Portuguese islands, lying about 300 mi. off Cape Verde on the West African coast, between 17° 13' and 14° 47' N. lat. and 22° 40' and 25° 22' W. long. The group with an area of 1,475 sq. mi. consists of 14 islands, including the inhabited Santo Anteo, Sao Vicente, Santa Luzia, Sao Nicolao, Sal, Boa Vista, Maio, Sao Thiago, Brava and Fogo.

The entire group is volcanic in origin, and the highest peak, Fogo, which exceeds 9,000 ft., has only recently become extinct. The prevailing northeast trade winds render the islands generally arid, but mountain-fed rivers provide fertile valleys. The islands take their name not from the vegetation, but from the green sargasso weed which drifts here from the middle of the Atlantic. The seat of government is Sao Thiago, but the chief commercial center is Sao Vicente, an important coaling station and port of call for European vessels engaged in the South American trade. Coffee, hides, sisal, oranges and maize are among a large variety of products. Imports, largely consisting of coal for shipping, are valued at about

\$2,250,000 annually; the exports reach only about \$150,000. The islands were discovered in 1456 by the Portuguese. Pop. 1928, 150,160.

**CAPILLARY**, the minute blood vessel connecting an arteriole with a venule (*see* VASCULAR SYSTEM). A capillary is composed of a single layer of flattened endothelial cells which are attached to one another by their edges. It is by reason of the thinness of this wall that it is possible for food to pass to the tissues, for the interchange of oxygen for carbon dioxide to take place, for water to diffuse between blood and tissues, and for white cells to leave the blood stream in INFLAMMATION.

The wall of a capillary, being a semi-permeable membrane, the law of osmosis regarding the diffusion of substances is allowed to assert itself. This makes possible the nourishment of the tissues through a closed system of tubes. When a white blood cell (*see* BLOOD) leaves the stream, however, a small space is created between two cells, and the cell slips out by amoeboid motion.

Recent studies have demonstrated by various experimental procedures that capillaries have the power of independent contraction. During rest, some capillaries are entirely closed. When exercise places a greater burden on circulation, these resting vessels open to the passage of blood. Furthermore, capillaries dilate or contract under different mechanical or thermal conditions, independently of the arterioles. The nervous arc for these reflexes is thought to be confined to a single nerve fiber, and not to enter the spinal cord.

The capillary pressure has been found to be very low compared to the pressure in the arterioles. It varies, but is approximately equivalent to that of one or two inches of water. This pressure, though slight, must be met by a certain amount of active tone in a vessel as thin as a capillary. For the control of this tone the secretion of the PITUITARY GLAND is thought to be responsible.

During the past few years studies of the capillaries have aided the explanation of the mechanism of surgical shock, edema, interchange of food and waste, and certain disorders of the circulation. W. J. S. K.

**CAPILLARY PHENOMENA.** The rise of oil in a lampwick and of coffee in a lump of block sugar are familiar illustrations of the rise of liquids in capillary tubes. This rise, however, occurs only with liquids that wet (or readily spread over) the wall of the capillary. Mercury does not wet glass, so it is actually depressed in a glass capillary. This wetting really involves an attraction to the solid wall and is accompanied by a concave curvature of the liquid with a greater curvature and a greater rise for the smaller capillaries.

In such well-known ultra-porous solids as gas-mask charcoal and silica gel, the capillaries, occupying a large fraction of the total apparent volume, are of the order of five millimicrons (millionths of a millimeter) in diameter, too small to be seen with the best microscope. (*See also* CARBON, ACTIVATED.)

In such extraordinarily small capillaries, vapors or

gases such as sulphur dioxide, ammonia, ether, gasoline moisture, etc., may be condensed to liquids, because the smaller the capillary, the lower the vapor pressure of such condensed liquid. Air at temperatures near enough to its boiling point will also condense to liquid in the pores. Temperature and partial pressure and nearness to the boiling point of the liquid whose vapor is adsorbed are important factors. *See also* SURFACE TENSION. H. N. H.

**CAPILLARY TUBE**, a hollow tube of small bore. The name comes from the Latin *capillus*, a hair; hence, a hair-like tube. The fact that SURFACE TENSION causes liquids to rise in such tubes is of considerable importance and is called *capillarity*. Capillarity accounts for the rise of sap in plants and of oil in the wick of lamps.

**CAPILLARY WAVES**, waves in which the greater part of the propagating force is due to SURFACE TENSION, usually called ripples. Pure capillary waves have a WAVE-LENGTH of 1/10 in., or less. The large waves that are seen on the surface of a large body of water are called *gravitational waves*, because gravity is the chief cause of their existence.

The surface tension of a liquid acts like a thin, elastic membrane stretched over the surface and tends to flatten any raised portion and to level a depression. The surface tension, therefore, furnishes the restoring force of the displaced liquid particles which is necessary for the propagation of the wave motion. The pressure under the surface due to surface tension increases with the increase of the curvature of the surface, i.e., with decrease in wave-length. Since the surface tension effect is small, it need be accounted for only when the waves are very short.

It can be shown that if  $v$  is the velocity of a wave along the surface of a liquid of which the depth is not less than the new wave-length,  $\gamma$ ,  $d$  the density,  $T$  the surface-tension constant of the liquid, and  $g$  the force of gravity:

$$v^2 = \frac{g\lambda}{2\pi} + \frac{2\pi T}{d\lambda}$$

then, from this expression it may be seen that if the wave-length,  $\lambda$ , is great, the term,  $\frac{2\pi T}{d\lambda}$ , becomes small when compared to  $\frac{g\lambda}{2\pi}$  and may be neglected.

On the other hand, if  $\lambda$  is small,  $\frac{2\pi T}{d\lambda}$  becomes larger compared to  $\frac{g\lambda}{2\pi}$ ; hence, in this case, the surface tension effect becomes important in the propagation of waves. E. J. M.

**CAPITAL**, a fund of money or credit by the investment of which one can earn INTEREST and PROFITS. This financial concept of capital is now recognized to be quite as important as is the instrumental or technological concept, by which capital consists of the goods used in production, save land. Many economists class land as capital, but in analysis of the distribution of income the two should be kept distinct.

In J. S. MILL's definition, instrumental capital consists of produced goods used to produce more goods. Land is not produced goods. Moreover, nature limits it in amount, while capital (either instrumental or financial capital in the form of the loan fund) can be increased within limits determined only by the will to save and by productive capacity.

It is an old dictum that capital is both produced and saved (J. S. Mill). This statement confuses money capital with instrumental capital or what J. B. CLARK calls capital goods. What is saved is MONEY. It is saved by not being spent for consumers' goods. Only in this sense is capital saved. Capital goods, or the instruments of production, are produced, and serve their purpose only by being used and worn out. Saving money income (not spending for current consumption) provides a fund for the purchase of the labor and instruments essential in the process of production. Financial capital is thus purchasing power directed into productive rather than consumption channels.

This productive purchasing power is greatly expanded by the operations of the banking system in the creation of credit. In a very significant sense the banks create capital. A dollar saved and deposited in a bank becomes a part of the banking reserve, on the basis of which a dollar in the vault is made warrant for the creation of several dollars' worth of purchasing power, through the expansion of bank loans. Thus the banking system (*see BANKS AND BANKING*) through the banks' skillful coordination of cash reserves, loans, and deposits created by loans, increases the loan fund to several times what it could be if it consisted only of cash, and thus enables business to expand much further than it otherwise could.

Tracing the life-history of a specific thing through the process of manufacture, classical economists (*see CLASSICAL SCHOOL OF ECONOMICS*) concluded that capitalistic production is a roundabout process, which takes time. Hence a fund of purchasing power must be available to bridge the interval between the initiation of the process and the receipt of payment for goods produced. This is "saved" money capital. Saving involves the sacrifice of abstaining from spending for consumption goods and waiting to get one's principal back until the round-about productive process has been completed. The saver or abstainer has to be paid interest for his sacrifice.

It is argued by J. B. Clark and his followers that the capitalistic process is a continuous process, that capital synchronizes labor and product, and that capitalistic production therefore does not take time. Hence saving is necessary only when the productive process is being expanded by the building of new plants and new equipment which is not meant for replacements. This theory is fruitful to an understanding of the place of capital in the complex productive process as a whole.

A. B. W.

**CAPITAL**, in architecture, the topmost member of a column, on which the superstructure is carried, frequently projecting to give a more solid bearing for the

weight above, and accented with moldings or ornament in order to give an aesthetic feeling, and the appearance of being an adequate support. Capitals have been used in many styles, in widely separated cultures, and from early dates. In general, they may be divided into five types: the slab, cushion, bell, bracketed and wreath, or collar types.

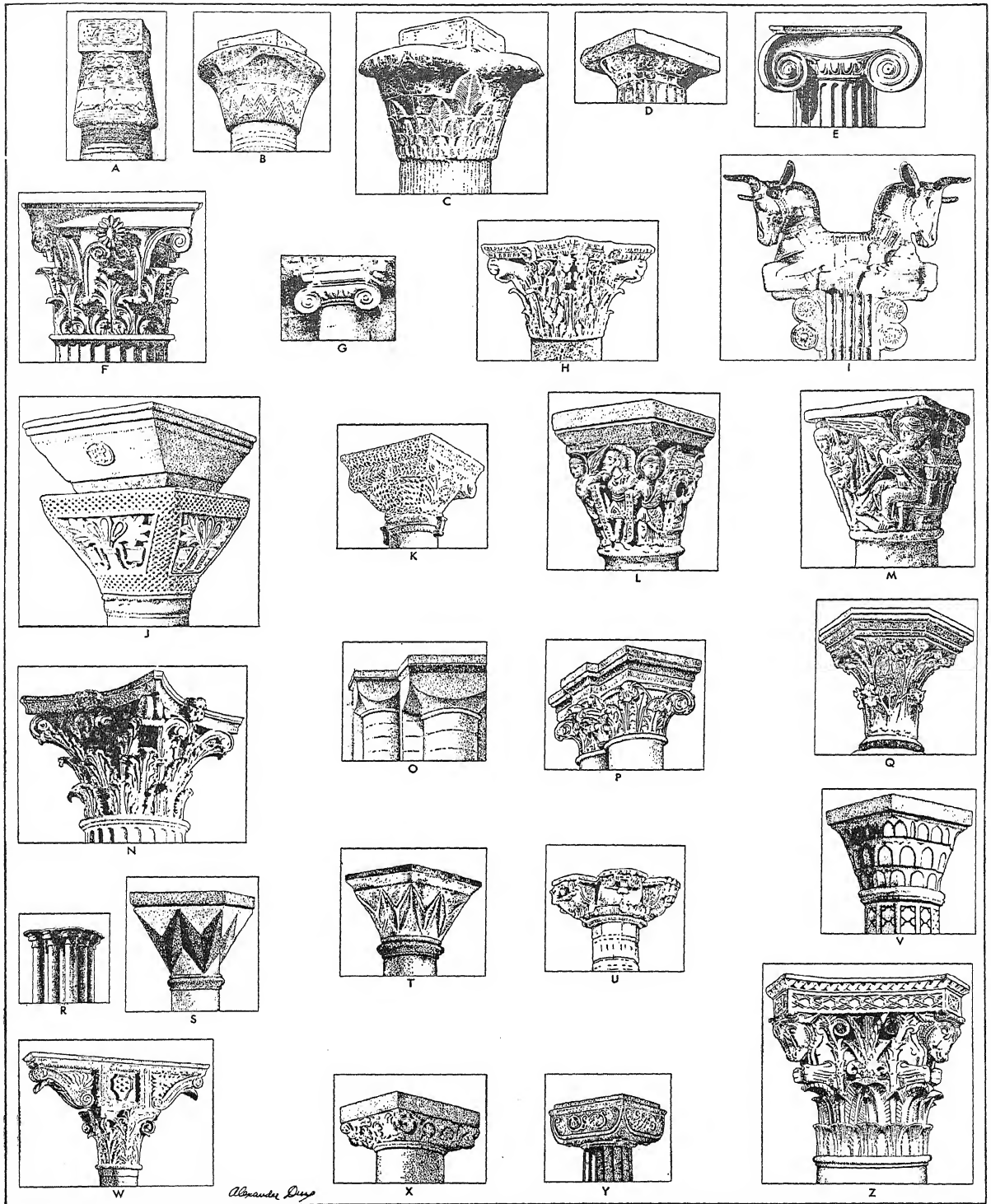
The slab type is best seen in certain early Egyptian capitals, sometimes called "Proto-Doric," in which a simple square block or abacus crowns a polygonal or fluted column. Certain types of Doric capital approximate the slab type, but the projecting curved molding, the echinus, below the slab suggests the cushion type. The cushion type consists of those in which the projection of the capital is made by simple convex geometric forms. The echinus, or curved projecting molding, of the Doric capital is a simple example. The type appears in the pre-Hellenic Aegean work as early as the beginning of the second millennium B.C. Other varying shapes of cushion capital are found in Byzantine work, often covered with finely cut surface decoration, and in the Romanesque styles of Lombardy, Normandy and England, in which the type is given many different and varying geometric shapes through scalloping, cutting off corners, and other measures.

The bell capital is well illustrated in Egyptian capitals of the lotus bud, palm leaf and campaniform types, in the classic Corinthian, and in many Gothic types, in which the bell is surrounded by leaves, scrolls, or crockets. In the Corinthian capital, the abacus, with its concave sides, has its corners supported on scrolls; and two rows of acanthus leaves surround the bell. The Corinthian capital had a tremendous influence on medieval capitals, and the tradition of its general shape is present in many Romanesque and Byzantine capitals even when the decoration is entirely different. Some French Romanesque capitals are close imitations. The typical crocket capital of the early Gothic period probably owes something of its design to the same tradition. In the bracket capitals, the column supports a long, generally rectangular block, which brackets out the

#### TYPES OF THE CAPITAL

(See opposite page)

A, Lotus bud. Temple of Khonsu, Karnak, Egypt; B, Campaniform. Temple of Sebek and Haroeris, Kom Ombo, Egypt; C, Papyrus. Temple of Khnum, Esna, Egypt; D, Doric. Parthenon, Athens; E, Ionic. Temple of Apollo, Delphi; F, Corinthian. Tholos of the Hieron of Apollo, Delphi; G, Roman Ionic. Theatre of Mithras, Rome; H, Roman, now in the Museum of the Baths of Diocletian, Rome; I, Persian. Palace of Artaxerxes, Persepolis; J, Byzantine. San Vitale, Ravenna; K, Byzantine. Church of St. Sophia, Constantinople; L, French Romanesque. Notre Dame du Port, Clermont-Ferrand; M, French Romanesque. Moissac, France; N, Corinthian. Church of San Lorenzo, Rome; O, Romanesque. Durham Cathedral, England; P, English Gothic. Trinity Chapel, Canterbury Cathedral, England; Q, French Gothic. Cathedral of Notre Dame, Chartres, France; R, English Gothic. Salisbury Cathedral, England; S, Turkish. From Moslem additions to the Church of St. Sophia, Constantinople; T, Turkish. From Moslem additions to the Church of St. Sophia, Constantinople; U, Indian. Mosque of Akbar, Agra; V, Indian. Zenana (palace pavilion), Mysore; W, Italian Renaissance. Badia at Pistoia, Italy; X, Swedish. City Hall, Stockholm; Y, modern Swedish. Interior of the City Hall, Stockholm; Z, modern American. Nebraska State Capitol, Lincoln, Nebraska. Bertram G. Goodhue, Architect.



TYPES OF THE CAPITAL  
(See page 424)



support, and so either reduces the span of the superstructure, or enables a thin column to support arches of great thickness. It is naturally the common type where wood construction is important, and may be due to primitive wooden origins. Its most important masonry developments are shown in the typical Achamaenian Persian capitals, where the bracket forms are carved with the fore parts of bulls or horses, occasionally supported on a molded bell and a combination of scrolled forms (*see NEAR EASTERN ARCHITECTURE, ANCIENT*); and in the classic Ionic capital, whose volutes, or spiral scrolled ends, are the later refinements upon earlier, much more spreading types. (*See GREEK ARCHITECTURE; IONIC ORDER.*) Simple bracket capitals, with the ends roughly shaped, or decorated with crude leafage, are found in many early Romanesque buildings. They were used to enable slim columns to support thick arches, and the long way of the bracket was across the thickness of the supported wall.

In the wreath type, the column is ringed at its top by a wreath-like form either of moldings or foliage. Although occasional rich types of Romanesque capital approach the wreath type, the clearest examples are those of the English Gothic. In the early English style the capitals often consist merely of a series of moldings ringing the shaft, and without any clearly marked abacus. In the decorated period the moldings are often replaced by elaborate, naturalistic convex sided wreaths of foliage under a circular abacus. In the perpendicular period there was a return to the molded capital, and an occasional use of forms of the bell type.

The grotesque or figured capitals of the developed Romanesque period fall often outside any of these classifications. In shape they approximate sometimes the cushion, sometimes the bell types, but it is their decoration that makes them unique. They furnished the Romanesque sculptor with unlimited opportunities to exercise ingenuity and creative skill. They are remarkably alike for the skill of their decorative treatment, and the verve, imagination and beauty of the figures upon them. Animals, real and imaginary, and human figures, are combined with foliage in endless variety, and the subjects of the figured capitals include not only biblical scenes and scenes from the lives of the saints, but genre scenes, and even figures taken from classical mythology. The best of these grotesque capitals are found in northern Spain and southwestern France. (*See SCULPTURE, MEDIEVAL.*)

Mohammedan capitals are of three sorts: those based on the Roman Corinthian and Byzantine types, found in early examples in Egypt, Syria and Moorish Spain and Africa; those developed later in the Moorish lands, in which simple surfaces curving up from the circular top of the shaft to a rectangular top are covered with intricate, conventionalized, fine scaled flat foliage; and those typical of Turkey and Persia, which are purely geometric, and based on the little niche and bracket forms called *STALACTITES*. (*See MOHAMMEDAN ARCHITECTURE.*) The capitals used in Indian

architecture prior to the Moslem conquest are extraordinarily rich and varied. At times, especially in Dravidian work, the appearance is almost classical; at times there is the utmost extravagance in molded and carved brackets, with figures, and sometimes strange carved drops. The tradition of earlier forms in wood is to be seen almost everywhere. (*See INDIAN NON-MOSLEM ARCHITECTURE.*) In China and Japan, where a wooden construction was developed in which many of the main beams were mortised into, rather than supported on, the posts and columns, capitals do not appear. (*See CHINESE AND JAPANESE ARCHITECTURE.*)

Modern methods of construction have tended increasingly to diminish the importance of the capital, and modern theories of functionalism and structure as the basis of design have frequently led to its omission even when columns were used. In occasional so-called modernist work, however, especially in Scandinavia and the United States, interesting forms, often distantly based on classic precedent, have been used. *See ORDER; GREEK ARCHITECTURE; ROMAN ARCHITECTURE; GOTHIC ARCHITECTURE.* T. F. H.

**CAPITAL, EXPORT OF.** Capital is said to be exported when the citizens or government of one country make investments in another country. An exportation of capital may arise from many different transactions. Chief of these are the purchase of the securities of foreign corporations and governments either in large blocks by domestic underwriting syndicates or in small lots by individual investors; the operations of domestic speculators upon foreign stock exchanges; investments by domestic corporations in branch plants, selling agencies, and other properties in foreign countries as a regular feature of their productive operations; direct loans by one government to another; short-term loans by BANKS and other financial agencies to similar institutions in foreign money markets.

The United States prior to 1914 had been a capital importing country for well over a century, but between 1914 and 1919 the outflow of capital amounted approximately to \$19,000,000,000 with \$9,000,000,000 exported by private individuals and \$10,000,000,000 loaned directly by the government.

Following the World War the export of capital on private account continued at a rapid rate. Over \$15,000,000,000 was sent abroad between 1919 and 1929. Many of the earlier loans were being repaid, however. Government loans in particular showed a substantial decline if we measure their volume by net present value. This was partly through repayment but more through a process of downward revaluation. Considerable amounts of capital were again being imported particularly for short-term loans in the New York MONEY MARKET and for operations in the stock market. All in all it seems that an international balance sheet of the United States in 1929 would have shown about \$24,000,000,000 due to it and about \$9,000,000,000 due by it, leaving a net balance of \$15,000,000,000. Over one-fifth of its total foreign invest-

ments have been made in Canada. Great Britain is second with close to one-tenth. Other important countries are Cuba, Germany, France, Argentina, Chile, Brazil, and Italy in the order named.

The economic effects of the export of capital are felt in many directions. In the first place it means a loss of capital to the exporting country and as such may react unfavorably upon industrial conditions in that country. Such was a common complaint in Great Britain before the World War. In the second place, it tends to develop the importing country industrially and thus may develop a vigorous competitor with the exporting country. More immediate effects, however, are felt on trade. Generally speaking exports of capital stimulate exports of merchandise. This influence will appear directly if a loan is floated for the express purpose of purchasing goods. Indirectly it will appear through the changes caused by an outflow of capital on exchange rates and prices. If the proceeds of the loan are transferred out of the country the consequent rise in exchange rates will stimulate EXPORTS and discourage IMPORTS. Or, if GOLD is exported prices will tend to fall and thus make the country a more profitable one in which to buy and a less profitable one in which to sell. Thus exports are again encouraged and imports retarded. See also BALANCE OF TRADE; INTERNATIONAL PAYMENTS; FOREIGN TRADE; REPARATIONS; FOREIGN EXCHANGE.

A. F. L.

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**CAPITALISM**, a system of economic organization featured by an elaborate and rapidly changing network of economic institutions, chief of which are business enterprise for private profit; private property; machine technology; a price mechanism and open markets. While earlier economic systems centered about the idea of earning a livelihood, the terms of which were largely fixed by custom and status, the spirit of capitalism is acquisition of money income, achieved by the sale of products or services on an increasingly impersonal market. Werner Sombart, a leading student of capitalistic evolution, distinguishes the spirit, the form, and the technology associated with capitalism. The spirit of this type of organization he holds to be dominated by "the positive drive toward boundless acquisition," the existence of competition, and an application of rationality to the guidance of economic processes. In this connection, stress is laid upon the character of the capitalistic unit in its highest development. "Profits, no matter how large, can never reach a level sufficiently high to satisfy the economic agent." Consequently the system becomes dynamic and potent. "A human being is regarded merely as labor power, nature as an instrument of production, life as a commercial transaction."

With such emphasis upon acquisition, business operation becomes a problem in exact calculation and planning of economic processes within an economic

unit—for example, a steel company. But between various business units little coordination exists.

The form of business enterprise has rapidly altered as the capitalist system has aged. The early enterpriser who was manager, owner, and possibly seller—who furnished the ideas and guided their fulfillment—has been dying out. In his stead, functional specialists are arising. Absentee owners supply funds, often through BANKING channels. Management comes to be centered in the hands of specialists. Transportation and MARKETING become separate techniques, themselves highly subdivided. The employed worker becomes widely separated from the controlling management. Even risks of ownership are borne in varying degrees as new types of STOCK and BONDS are devised. And these types of securities take on an aspect of increasing complexity with the formation of HOLDING COMPANIES and INVESTMENT TRUSTS. Control of machinery and factory equipment is more and more vested in CORPORATIONS as technological advance deprives the craftsman of his tools.

The instrumentality which has made possible the growth of capitalism and which at the same time has been stimulated by certain of the institutions associated with that system, has been machine technique. For upon the growth of factory organization, the invention of machinery, and the harnessing of WATER POWER, STEAM, and ELECTRICITY, the system has secured its strength. Indirect methods of production have augmented production, bringing ever-larger pecuniary gains. But such gains are only temporary, due to the force of competition among owners or the limitations of the PATENT system. Consequently, producers have been motivated to search out devices for rationalizing to an even greater extent the fabricating processes and invention has been stimulated in order that a differential profit may be secured.

It is too early to say whether capitalism is a system which promises to survive for an extended period. Among its elements of strength should be noted its ability to rationalize economic processes, bringing forth vast quantities of goods at decreasing costs; the inventive genius which it has stimulated; and its ruthless alteration and destruction of medieval social institutions. It has, in a word, assisted in the shaking up of the world of politics, of philosophy, of religion and of ethics. But it is doubtful whether it has created an altogether satisfying solution to problems of human welfare. Indeed, the system has a number of pervasive ills. It is as yet poorly coordinated, bringing resultant depression, economic mal-adjustment and distress in its wake; the dollar calculus has been so widely extended as to make the acquisition of riches a too dominant motive in life; and the gains from machine production have too largely gone into the hands of a small group of owners, creating a gulf between social classes which is difficult to bridge.

C. E. W.

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**CAPITALIZATION**, a term having three distinct meanings: 1. the total par value of a corporation's authorized capital stock; 2. the total par value of a corporation's outstanding stocks and bonds; 3. the valuation placed upon the earning power of a corporation, a piece of land, or other income yielding property. The authorized capital stock is stated in the corporation's CHARTER, and represents the maximum amount of stock that may be issued without amendment of the charter; for example, 1,000 shares with a par value of \$100 a share. The par value of a share of stock is the amount which the original subscriber is legally presumed to have paid the corporation for the stock. Not all the AUTHORIZED STOCK need be issued. If a corporation with an authorized capital stock of \$100,000 issues \$50,000 of this stock, and then issues BONDS to the amount of \$75,000, its capitalization in the sense of outstanding stocks and bonds is \$125,000.

Capitalization in the sense of valuation of earning power means essentially an estimate of the present value of future income compound discounted at a rate reasonable under the circumstances. This valuation will depend upon the amount of the expected income, the time and certainty of payment, and the current rate of return on risk-free investments. When the rate of return on risk-free investments is 5% a year, a perpetual and certain income of \$5 a year has a capitalized value of \$100, representing the present value of the \$5 annual payments compound discounted at 5% a year. Because of its uncertainty, the earning power of a corporation is usually capitalized at a higher rate than the rate of return on a risk-free investment. The capitalization of the earning power of a corporation whose securities are listed on the Stock Exchange is represented by the total market value of its stocks and bonds, which may be greater or smaller than the total par value of those stocks and bonds.

Corporations whose earnings are expected to exceed a fair return on the amount actually invested in the business often issue securities with a par value in excess of the sum invested—large blocks of stock being given to promoters and others in exchange for more or less fictitious services. This represents capitalization on the basis of anticipated earning power rather than on the basis of original cost. If the anticipated large earning power fails to materialize, the market price of the stock will be low and the corporation may be said to be overcapitalized. On the other hand if the earnings become very large, the market price of the stock may rise far above par, and the corporation may be said to be undercapitalized. The corporation may then issue additional shares to its stockholders in the form of stock dividends or splits (see SPLITS). This tends to bring par value capitalization up to the market capitalization of earning power.

L. A. R.

**CAPITAL LEVY**, a form of taxation designed to capture for public use a portion of the CAPITAL levied upon. The source of this tax is capital itself, in contrast to property tax and estate or inheritance taxes,

the source of which is the income from the capital value. Property or estate tax rates may become so heavy as to absorb the entire current income and to encroach, in addition, upon the capital value itself. To this degree the source of these taxes becomes the capital itself, as in the capital levy.

Despite this fortuitous resemblance, the capital levy remains, in principle, *sui generis*, since there is no intention that the tax should be paid otherwise than by an absorption of a portion of the capital. While the idea of the capital levy is not new, this form of taxation received renewed and special attention in Great Britain and Europe after the World War, as a proposed means of reducing the immense WAR DEBTS. The forthright appropriation of a certain proportion of the national capital and the application of the proceeds of such a levy to debt retirement, it was argued, would eliminate, once for all, future taxation for debt service, and if progressive rates were used, it would at the same time equalize the distribution of WEALTH.

The practical difficulties of such a levy were usually overlooked or minimized by its advocates. The absorption of eight or ten billion dollars of wealth in a single taxing operation presents serious problems of liquidation and realization, to which the only alternative is that of governmental holding of shares and bonds, or of actual properties taken in payment of the levy. An extensive forced sale of securities or property would demoralize prices, while retention of the wealth collected under the levy would preclude its use for debt redemption.

These difficulties led to a complete transformation of the character of the tax in the experiments actually introduced in Continental Europe. Instead of being an outright appropriation of a certain proportion of the capital, provision was made for payment of the levy over a period of years. Thus the capital levy became, in effect, a special tax payable out of income. With this transformation went also, in most cases, a disappearance of the idea of large-scale debt redemption, since the proceeds of the tax were treated and used as ordinary revenue receipts.

The capital levy is a counsel of desperation. It is suggested only when disturbed or emergency conditions appear and under such conditions its levy and collection are highly impractical. H. L. L.

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**CAPITAL PUNISHMENT**. Punishment of crimes by death is as old as the human race. Since the Middle Ages the number of crimes carrying this penalty has steadily decreased until now murder is almost the only capital offense. Numerous governments have abolished capital punishment altogether.

Proponents of capital punishment claim that it is a crime deterrent and the only way of eliminating the hopeless enemy of society, as pardons and paroles nullify the effect of life sentences in prison. Opponents deny its deterrent effect, urge that it belongs to the era of vengeance rather than to that of penal

treatment, and assert that in practice it diminishes the certainty of punishment because judges and jurors are loath to convict when death is the penalty. Surveys seem to confirm this latter opinion. Long prison sentences with specialized treatment are offered as substitutes.

G. W.

**CAPITAL SHIP**, a warship, but not an AIRCRAFT CARRIER, with a displacement exceeding 10,000 tons, which carries a gun (see ARTILLERY) of greater caliber than eight inches.

**CAPITOL AT WASHINGTON, D.C.** The site of the Capitol building on a low hill at the east end of Pennsylvania Ave., was chosen by George Washington and Major PIERRE C. L'ENFANT because of the fine view of the 12 streets radiating from it. In 1792 there was a public competition for a plan with a prize of \$500 to the winner. Nothing satisfactory was submitted but later that year Dr. William Thornton submitted acceptable plans, calling for a building in the neo-classic spirit. The corner stone was laid on Sept. 18, 1792, in the southeast corner of the old north wing, now the Supreme Court section. Building was carried on with great opposition by the successive superintendents, Stephen Hallet and George Hadfield. Sandstone instead of marble was used and the plans were often detrimentally changed.

Congress first met in the new Capitol on Nov. 17, 1800, though much building remained to be done. During the War of 1812, the interiors of the completed north and south wings were burned by the British and it was necessary to erect a temporary building for the government. There was further disagreement in rebuilding the Capitol until Charles Bulfinch, who remained in charge for 10 years, was made supervising architect in 1817. Congress occupied the new hall in 1819. After 1825 attention was given to details on the exterior and landscaping of the extensive 22-acre park. Only the central area was finished at this time. The present area is 58.8 acres.

A new hall of Representatives was completed in 1857 and the new Senate hall in 1859, with T. U. Walter as architect. Both are built of white marble. The dome was raised as a requirement of the new dimensions. Still further expansion in 1903 brought the total building cost above \$16,000,000. As it now stands the Capitol is 751½ ft. long, 350 ft. wide, and 287 ft. 5½ in. high. The central building is the seat of the Supreme Court, the north wing is the Senate Chamber and Congress convenes in the south wing.

Corinthian columns are the main exterior decorations. Three magnificent bronze doors bearing famous historical scenes in relief are at each of the main entrances. A fine collection of historical paintings is in the rotunda under the dome, and Statuary Hall has a notable assemblage of statues placed there by the various states who have the right to designate two statues each. The grounds now comprise about 50 acres.

**CAPITULATIONS**, treaties and customs upon which the practice of EXTRATERRITORIALITY in Turkey

rested. Under this system, citizens of non-treaty powers and natives of Turkey could claim the protection and the good offices of the treaty-powers. Capitulations are also agreements setting forth the conditions of surrender of troops, places or both.

**CAPORETTO, BATTLE OF**, an Austro-German offensive in the WORLD WAR, launched Oct. 24, 1917 on the Italian front. Caporetto marked an Allied disaster on the southern front, where they had hoped to cause the collapse of Austria-Hungary. It was otherwise noteworthy as a projection of Napoleonic tactics in modern warfare. After the Italian offensive in the late summer of 1917, Germany was forced to come to Austria's aid. Gen. Otto von Bülow was given command of seven German and nine Austrian divisions, supported by 2,500 guns and 500 trench mortars, with which to strike in the Tolmino Sector, push the Italian armies west across the Isonzo River, and retrieve Venetia. The German command knew that the line between Tolmino and Caporetto, west of the main front, and north of the Bainsizza plateau, was vulnerable, and it was decided to strike with full force at that point, a perfect bit of Napoleonic strategy. The attack was launched Oct. 24. Under its weight the Italians retreated across the river, abandoning Caporetto. The following day the Austro-German forces had taken the chief passes and heights along the entire east side of the great Italian salient, and von Bülow began to close in from the northeast, pressing the panicky Italians across the Tagliamento. Gen. Cadorna was unable to halt the Italian retreat until the troops reached the Piave on Nov. 4. Italian casualties were 320,000; in addition Cadorna lost 265,000 troops taken prisoners, 3,000 guns, 1,700 trench mortars, and approximately 4,000 square miles of territory.

**CAPPER, ARTHUR** (1865- ), American legislator and publisher, was born at Garnett, Kansas, July 14, 1865. After acquiring a high-school education he became, in 1884, a compositor on the *Topeka Daily Capital*, for which paper he worked as reporter, city editor and Washington correspondent, becoming owner and publisher in 1892. Later he established *Capper's Weekly*, *The Kansas Farmer*, and several other agricultural publications. He was governor of Kansas 1915-19, and in 1918 was elected to the United States Senate as a Republican. Capper was reelected in 1924 and again in 1930. As a prominent member of the so-called "farm bloc," he has consistently advocated farm relief legislation.

**CAPRI**, a mountainous island about 4 sq. mi. in area, lying off the western coast of Italy. Its picturesque outline is a feature in the view of the Bay of Naples. The ancient *Capreae* (*caper*, goat) was the favorite residence of the emperors Augustus and Tiberius. The island has about 8,000 inhabitants. Fruit and olive trees, and vineyards abound. The flora comprises 800 species. The islanders derive their income chiefly from the large numbers of tourists who are attracted particularly by the Blue Grotto, a lovely sea cave which can be entered by boat. The little

town of Capri, with less than 5,000 inhabitants, is located between two hills, one crowned with ancient ruins, the other with remains of a medieval castle. It has a church, a former Carthusian monastery and the ruins of the Villa di Tiberio. The second town, Anacapri, has about half as many inhabitants. The houses have an oriental appearance. Numerous religious festivals attract large numbers to the island, and it is a favorite resort for artists.

**CAPRICORNUS** (gen. *Capricorni*), the goat, the tenth constellation of the Zodiac, is visible during the early evenings in September or October. It contains only stars of the third magnitude and fainter. Delta Capricorni belongs to the nearer stars, being only 30 light years distant. Alpha is a double star recognizable to the naked eye since its components are 6 minutes of arc apart. Beta is a double star recognizable only through a telescope. From the fact that some 20 to 30 centuries ago the sun stood in the constellation Capricorn on December 22, the shortest day of the year, and the beginning of winter for the northern hemisphere, that line on earth where the sun passes overhead on that day and which marks the southern limit of the tropical belt is named the tropic of Capricorn. See *STAR: map*.

**CAPRIFICATION**, the fertilizing of figs by a tiny wasp (*Blastophaga*) breeding only in so-called "fruits" of the wild caprifig. Botanically the fig is a hollow, fleshy receptacle containing many minute flowers and subsequently nutlets, constituting the true fruits. The Smyrna fig, valuable for drying, bears only female flowers. Pollination, essential to the setting of fruits, is accomplished by suspending caprifigs, swarming with wasps, among the branches of cultivated trees. Pollen-laden wasps, entering the strange figs in search of suitable blossoms in which to deposit eggs, fertilize practically every flower. The struggle to establish this useful little wasp on California fig-plantations makes a fascinating chapter in horticulture. Smyrna growers long contrived that caprifig-cuttings exported should not contain wasps. In 1899 the U.S. Government succeeded in importing the Algerian *Blastophaga*. It later developed that the wasps had become accidentally established near Modesta, Cal., 30 years before.

**CAPSIAN CULTURE**, the stage of culture following the ACHEULIAN and MOUSTERIAN stages and corresponding to the Aurignacian stage of Europe. It is represented by discoveries at the site of the ancient Capsa, the modern Gafsa, in Tunisia, north Africa. The later SOLUTREAN CULTURE and MAGDALENIAN CULTURE are absent from north Africa, being represented by the later stages of the Capsian. Flint knives and scrapers of the Capsian are of the Aurignacian type; flint flakes in the later Capsian gradually diminish in size, taking the character of the pigmy Tardenoisian flints. It is therefore held that the culture of the Tardenoisian stage developed in north Africa and later entered Europe through Spain.

To the Capsian culture belong the cave wall paintings at Alpera and Cogul in Spain. Europe appears

to have been indebted to the Capsian culture for the introduction of the bow and arrow, which are well shown in the wall paintings at Alpera and elsewhere in Spain, but their use seems to have been confined to Spain. There is no conclusive proof of palaeolithic archery north of the Pyrenees. Conventionalized human figures in the Capsian wall paintings are held to be the models of some of the Azilian painted pebbles. See *ARCHAEOLOGY*.

**CAPSTAN**, an upright cast iron drum or barrel to which power may be applied, that is mounted on a spindle. The barrel has ribs or cleats around which the rope passes, and may be turned either by hand as by pushing levers (called capstan bars) put in the drum head of the barrel, or by gearing in the base connected to an electric motor or steam engine. Capstans on ships are used for warping, moving weights and for a variety of other purposes.

**CAPSULE**, in botany, a dry seed vessel or fruit, composed of two or more carpels, forming a compound pod that splits open when ripe, as exemplified in the lily, poppy, gentian and numerous other flowering plants. See also *FRUIT*.

**CAPTAIN**, in the Army, an officer ranking between first lieutenant and major. He commands a company, troop or battery in the infantry, cavalry or artillery respectively. The captain is responsible for the conduct of his command; for its equipment; for the feeding, clothing, and pay of his men; and for the maintenance of accounts, records and reports.

In the Navy, the captain is the commanding officer of a warship and ranks next to the rear ADMIRAL. He ranks with the COLONEL of the Army.

**CAPTAINS COURAGEOUS**, a realistic novel by RUDYARD KIPLING; published 1897. It was originally designed for boys and deals with the life of Gloucester fishermen on the high seas. On his first trip to Europe the pampered young millionaire, Harvey Cheyne, is washed overboard near the Newfoundland Banks; he is picked up by the schooner *We're Here*, whose rough but kindly captain, Disco Troop, eventually makes a man of the spoiled youth. The technicalities and language of the cod-fisheries are employed with skill and great effectiveness.

**CAPUA**, also Campanus, one of the most prosperous cities of ancient Italy, located in the province of Caserta on the River Volturno. It was founded by the Etruscans and soon became known for its purple and scarlet dyes and fine linens. In 420 B.C. it was captured by the Samnites, and in 343 B.C. it placed itself under the protection of Rome. After the Battle of Cannae, Capua went over to Hannibal, but in 211 B.C. Rome retook the city and punished it severely. In the barbarian invasion Capua was destroyed. The modern Capua is built 3 mi. distant.

**CAPUA, SIEGE OF.** See *ROME, HISTORY OF*.

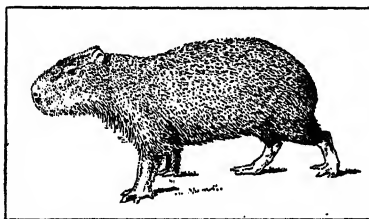
**CAPUCHINS** (Italian *cappuccio*, cowl, hood), popular name for the Friars Minor of the Order of St. Francis, Capuchin. Matteo di Bassi in 1525, and two other Franciscan friars the following year, obtained permission from Clement VII to dwell apart



from their community in the Marches of Italy in order to follow the Rule of St. Francis more perfectly. Joined by others, they became independent of the Observant superiors in 1528, and the year after, numbering 18 friars and four hermitages, held their first chapter at Albacina and formulated the new constitutions. The reform spread rapidly but retained its fundamental characteristic, simplicity of life. The Capuchins were considered the direct spiritual descendants of the *poverello*. The popularity they derived from heroic services during the pestilences of the late 16th and early 17th centuries redounded to the advantage of their missionary labors. By 1662 they had foundations throughout Europe and extensive foreign missions. French Capuchins were the first in North America (1632), and still maintain a Canadian province. There are now more than 11,100 religious in 957 convents and mission houses; also, over 4,000 students for the novitiate in 95 preparatory colleges. Provinces number 53. A congregation of sisters sometimes called Capuchinesses has been associated with the order since 1538.

**CAPULIN MOUNTAIN**, a national monument, created by presidential proclamation, Aug. 9, 1916, comprising 680 acres in northeastern New Mexico. The mountain is a recently extinct volcano and rises in a symmetrical cinder to a height of 1,500 ft. above the surrounding plain. The diameter of the base of the mountain is  $1\frac{1}{2}$  mi. The crater at the top is about 1,500 ft. from rim to rim and from 75 to 275 ft. deep. The mountain is 6 mi. southwest of Folsom, N.M., on the Colorado Southern Railroad and 3 mi. north of the town of Capulin on a branch of the Santa Fé system. The Colorado-to-Gulf Highway passes just south of the mountain. A well-packed cinder road enables automobiles to ascend from the base to the rim of the crater.

**CAPYBARA**, or **CAPYVARA**, the giant South American water-cavy (*Hydrochoerus capybara*) called by the natives carpincho. This bulky animal ranks as the largest living rodent. It is 4 ft. long, weighs



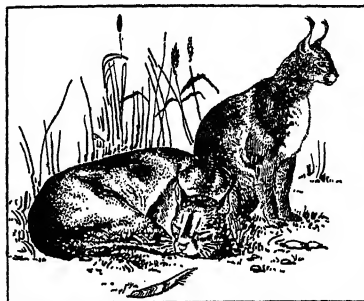
COURTESY N.Y. ZOOLOGICAL SOCIETY

CAPYBARA

about 100 lbs., has a blunt head, cleft upper lip, gnawing teeth, exceedingly short tail, and webbed feet with hoof-like nails. The gait is swinish; but a company of carpinchos basking on a grassy stream-bank look like rough-coated, enormously oversized guinea-pigs. Carpincho meat, not unlike veal, is esteemed dainty eating by pumas, jaguars, boa-constrictors and man. To escape their enemies, capybaras take to the water, where they dive deep and far,

swimming or hiding among water-plants, with only the nose exposed. These animals raid rice and sugarcane plantations. They are sometimes tamed.

**CARACAL**, the smallest of the lynxes. This swift and fierce little wild cat (*Lynx caracal*) is at home in grassy jungles throughout Africa and in parts of Arabia, Persia and India. The color is a uniform reddish fawn, set off by black-tufted ears and tail. The cheeks are unbearded. The caracal is an agile



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CARACAL

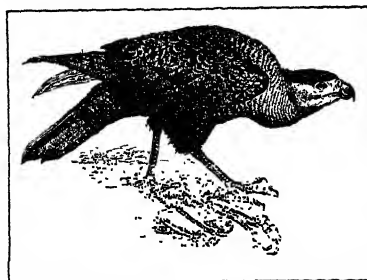
climber and a redoubtable hunter of antelope, hares and game birds of which last it sometimes brings down several at one spring. Like the cheetah, the caracal is kept captive by eastern princes, and trained for the chase. The fur, though beautiful, is not valuable enough for export; settlers of South Africa once held the superstition that the skin when worn in a coat or kaross was a remedy against rheumatism.

**CARACALLA, MARCUS AURELIUS ANTONINUS** (186-217 A.D.), Roman emperor from 211-217. Son of Septimius Severus, he murdered his brother Geta with whom he had jointly inherited the empire. In 212 he granted Roman citizenship to all free persons inhabiting the empire, thereby increasing his revenue from the inheritance-tax, or *Vicesima Hereditatum*, to which only Roman citizens were liable, and unifying the system of taxation. After campaigns on the Upper and Lower Danube, 213-214, he ravaged Mesopotamia wantonly in 216. He was murdered in 217 at the suggestion of Macrinus, prefect of the praetorian guard, his successor. The ruins of the enormous baths of Caracalla in Rome attest the extravagance of their builder.

**CARACALLA, EDICT OF**, 212, conferred Roman citizenship on all free-born inhabitants of the Empire, one outcast class excepted. This privilege, first extended to the Roman allies in Italy in 89 B.C., and hitherto gradually conceded to the provinces, had more legal, commercial and social than political importance during the early Empire. But it was now an empty honor, if not a burden, for it involved compulsory services, taxes and contributions to the State. The result of this Edict, besides extending the study of Roman Law, which was now universally applicable, was to nullify the value of citizenship and drain the last resources of the provinces.

**CARACARA**, the common name for a genus (*Polyborus*) of large American hawks with vulture-

like habits, so-called from their harsh cry. The Brazilian caracara or carancho (*P. tharus*), which ranges practically throughout South America, is about 2 ft. long, with blackish-brown plumage more or less barred with white, especially below, and a bare red face. It is largely terrestrial in habit, walking and running with ease, but is also powerful and graceful on the wing. Although the caracara subsists largely upon



AUDUBON CARACARA

carriion it preys to some extent upon other birds and various small animals. It nests in trees, on cliffs or sometimes on the ground, laying 3 or 4 cinnamon-colored eggs with darker markings. The similar but smaller Audubon caracara (*P. cheryway auduboni*) is found from northern South America to Lower California, Texas and Florida.

**CARÁCAS**, the capital of Venezuela, situated in 10° 31' N. lat., and 67° 5' W. long., 8 mi. inland on the southern slopes of the outer Cordillera, 3,035 ft. above sea level. The city, built in the usual Spanish-American style with beautiful plazas and promenades, is very attractive. The climate is good; only occasionally does the temperature go below 60° or above 80° F. The streets are narrow, though the one-story buildings make this hardly noticeable, and are paved in the outer parts of the city with cobbles, in the center with cement. Most of the private or business houses have only one story, but the public edifices have more. The principal square or plaza occupies the center of the town, and round it are grouped the cathedral, government offices, palace of justice, archbishop's palace, the Casa Amarilla, containing the archives, the general post-office and the principal hotel. On the hill of El Calvario west of the city is the observatory and Independencia Park, from which a fine view of the city is obtained. On the south of the Guaire, which is crossed by two bridges, is the Paraiso drive, on which are the villas of some of the wealthy inhabitants.

Tramway and telephone service are excellent; both utilities were begun and controlled by British interests. Electric power is derived from the falls of El Encantado and Los Naranjos, on the Guaire below Carácas. A new plant was erected in 1929. The city also has a brewery, foundry, and factories for manufacturing furniture, cigarettes, chocolates and matches. It is an export center for cacao, coffee and tobacco.

In 1567 Diego de Losadou founded the city of

Santiago de León de Carácas, as it was then called. The city began to prosper after the subjugation of the Indians in spite of invasion and robbery by pirates and destruction caused by civil war. In 1812 Carácas was badly damaged by an earthquake, and nearly 12,000 persons were buried in the ruins. Pop. 1924, 126,343.

**CARAPACE**, the bony encasing shell which protects the backs of certain animals, notably turtles, but that may also be a covering shield over the entire soft body, as with some turtles, pteropods and infusoria. The shield of the armadillo is generally grouped with such chitinous covering, although not always considered a true carapace.

**CARAT**, a unit used in weighing precious stones, such as diamonds; it is equivalent to 3.2 grains troy and comprises 4 jeweler's grains of 16 parts; also, a unit used in designating the fineness of gold, the pure metal being 24 carats fine.

**CARAVANSERAI**, a stopping-place in the Orient, located near a town but outside its walls, offering temporary accommodations to caravans and wayfarers. Generally, quadrangular in form, it incloses a courtyard sometimes of sufficient size to care for 300 or 400 camels or mules. Store rooms similar to cellars for sheltering the goods generally surround the courtyard. At a higher level an arcade joined to the courtyard by wide open flights of steps provides access to the sleeping quarters, which comprise small, low-ceilinged, unfurnished rooms usually having but one small window high up in the outer wall and a few holes for ventilation lower down. A caravanserai does not furnish food for man or beast, but merchants are usually on hand to offer their wares for sale. Cooking is done in a corner of the courtyard. These accommodations may be owned either by churches, municipalities or individuals.

**CARAWAY** (*Carum Carvi*), an annual or biennial herb of the PARSLEY family, widely cultivated for its aromatic seeds, native to the Old World and sparingly naturalized in the United States. The slender, furrowed stem, 1 to 2 ft. high, bears finely divided leaves, white flowers and strongly ribbed, oblong fruit. The seeds have medicinal properties, and are used as an aromatic condiment in cookery and confectionery.

**CARBAMIDE**. See UREA.

**CARBIDES**, chemical compounds of carbon with only one other element. Among the best known are those with calcium, iron, and silicon, while the numerous compounds of carbon and hydrogen are usually classed separately under the name HYDROCARBONS. Calcium carbide is prepared by heating lime and carbon; it reacts violently with water, yielding ACETYLENE. Silicon carbide, better known as CARBORUNDUM, is a product of the electric furnace, and is widely used as an abrasive; the large number of carbides of iron play an important part in determining the properties of steel.

**CARBINE**, a short, light RIFLE used by CAVALRY. The bands, swivels and stocks are usually slightly different from those of the rifle, facilitating carrying

on the saddle and easy handling in case of fire from the mounted position. Carbines usually fire the same ammunition as the service rifles.

**CARBOHYDRATES**, the natural and synthetic sugars, starches, glycogen, inulin, dextrins, cellulose, gums, and mucilages. These substances contain the elements carbon, hydrogen, and oxygen in such amounts that in the greater majority of cases the ratio of the number of hydrogen atoms to oxygen atoms is the same as in water. In other words, these substances may be looked upon as hydrates of carbon; hence the term carbohydrates.

**Composition.** The simplest carbohydrates contain only one aldehyde ( $\begin{smallmatrix} \text{H} \\ \text{R} \end{smallmatrix} \text{C}=\text{O}$ ) or ketone ( $\begin{smallmatrix} \text{R} \\ \text{R} \end{smallmatrix} \text{C}=\text{O}$ ), group with one or more alcohol ( $\begin{smallmatrix} \text{R} \\ \text{R} \end{smallmatrix} \text{C}=\text{OH}$ ) groups. These carbohydrates are called the *monosaccharides*, because they contain the arrangement essential to only one sugar group. The monosaccharides are divided into sub-groups depending upon the number of carbon or oxygen atoms per molecule which they contain—thus, we have bioses, trioses, tetroses, pentoses, hexoses, etc., and these may again be classified into aldoses or ketoses, depending upon whether the molecule contains an aldehyde or a ketone group. The best known examples of the monosaccharide group are the two most common hexoses: glucose and levulose.

This multiplicity of carbohydrates is due mainly to the peculiar changes introduced into compounds when identical groups or elements are arranged in different orders about the carbon atoms. As a result of these slight differences in molecular structure, these substances, when in solution, change the plane of polarized light to the left or right and to varying degrees, depending upon the carbohydrate. All the carbohydrates, other than monosaccharides, contain two or more sugar groups or monosaccharides per molecule. These are again named according to the number of sugar groups or monosaccharides they contain per molecule. Thus, when hydrolyzed, or split into the simplest sugars, the *disaccharides* yield two monosaccharides, the *trisaccharides*, three; and *polysaccharides*, many molecules of monosaccharides per molecule. Very nearly all of the known di-, tri-, tetra- and polysaccharides found in nature yield pentoses or hexoses when hydrolyzed. Those yielding pentoses are called pentosans, while the hexose-yielding are called hexosans. The most abundantly occurring disaccharides are cane sugar or saccharose, malt sugar or maltose and milk sugar or lactose. Among the polysaccharides should be mentioned starches, dextrins, glycogen, inulins, celluloses, gums and mucilages.

**Origin.** Carbohydrates originate, in the main, in the green plants through the action of sunlight and chlorophyll on water and carbon dioxide, forming carbohydrate and oxygen. Animals do not possess this power, although they are able to build up poly-

saccharides from simpler forms and to form carbohydrates from proteins and from the glycerine in fats. Our main source of the energy in carbohydrates, then, comes from the sun's energy and from plant life.

**Functions.** The functions of carbohydrates in nature are many. In the animal kingdom, glucose and glycogen constitute the main source of mechanical and heat energy. In plants, the glucose, saccharose and starch likewise serve as sources of energy for future use or for conversion into other forms of carbohydrate, such as the celluloses and pectins. The celluloses serve in the main as supporting elements in the architecture of the plant. Other complex derivatives of carbohydrates, such as mucins, chitins, cerebrosides and glucosides, serve in various specific capacities in animal and plant tissues. Thus the mucins act in part as lubricants, the chitins make up part of the protective shells of beetles, lobsters, crabs, etc., the cerebrosides occur quite specifically in nerve tissue, and the glucosides occur widely distributed in numerous specific combinations in plant and animal tissues.

**Varieties.** **GLUCOSE, GRAPE SUGAR OR DEXTROSE** ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), occurs very widely distributed in the plant and animal kingdoms. It is an important article of commerce, due largely to the ease with which it is prepared from starch. The starch is boiled with dilute sulphuric acid, the acid then neutralized and removed by the addition of lime, and the resulting solution evaporated to a syrup under diminished pressure. The solution thus made marketable contains glucose as the main constituent, but admixed with varying amounts of other sugars and derivatives thereof.

**LEVULOSE, FRUCTOSE, or fruit sugar** ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), occurs in nature to a much more limited degree, being present mainly in fruits and honey. Like glucose, it must be prepared from other sugars, such as inulin or cane sugar. It is sweeter than glucose, but its use in place of cane sugar is limited in part due to difficulties involved in its preparation.

**SUCROSE or saccharose** ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ), in the form of **CANE SUGAR, or BEET SUGAR**, is the most important sweetening agent and stands next to starch in importance as a carbohydrate food. (See SUGAR.) The two main sources are sugar cane and sugar beet. The amount of sugar present in both good cane and good sugar beet is between 12 and 13 per cent. The preparation of the sugar from these two sources is a highly technical matter which requires the most careful chemical control for production on an economic basis. The process consists essentially in the extraction of the sugar by water, the removal of proteins and other substances from this extract by lime and heat, the removal of the lime by carbon dioxide, the concentration of the purified extract in vacuum pans, the decolorizing by charcoal, the crystallization of the sugar, its separation and often its refining. Cane sugar is easily acted upon by very weakly acid solutions, a factor

which must be carefully controlled in the commercial production of granulated sugar. This hydrolysis is also readily accomplished by an enzyme called invertase. The products of hydrolysis are one molecule each of glucose and levulose for each molecule of saccharose or, in other words, saccharose is a disaccharide made up of the two hexoses, glucose and levulose.

The next most important disaccharide is LACTOSE or milk sugar ( $C_{12}H_{22}O_{11}$ ). This is prepared by evaporating the sweet whey obtained after removing the curd in cheese or casein manufacture, until, upon cooling, the crystalline lactose separates. This sugar is not used as a food, but largely as a diluent in medicinal products or as a carbohydrate in infant foods. It is split by boiling acids into one molecule of galactose and glucose each per molecule of lactose. It is not split by invertase, the enzyme which hydrolyzes cane sugar, but by another specific enzyme, called emulsin.

STARCH, amyllum or amylose, has the general formula ( $C_6H_{10}O_5$ ) $_n$ , where  $n$  indicates an unknown number but certainly more than four. Although the starch found in seeds and plants yields glucose as the final product of hydrolysis with dextrins and maltose as intermediate products, nevertheless, each plant appears to store starch as granules of rather specific microscopic appearance. These granules consist mainly of pure starch, but the protective coating of the granules appears to contain small amounts of amylopectin, phosphorus and fatty acids. Pure starch is converted from the insoluble into the soluble form by heating at high temperatures. If heated with water at high temperature for a longer time, it is converted into dextrins and very slowly into maltose and glucose. However, if boiled with dilute acids or if incubated with the enzymes, amylase and maltase, starch is rapidly converted into glucose.

GLYCOGEN or animal starch, ( $C_6H_{10}O_5$ ) $_n$ , is similar to plant starch in its chemical characteristics. It is the storage form of carbohydrates in animals. It is found mainly in the liver and in muscle tissue. *See also SUGAR; BIOCHEMISTRY.* F. C. K.

**CARBOLIC ACID.** *See PHENOL.*

**CARBON**, a non-metallic chemical element (symbol, C) having an atomic weight of 12. It occurs free in nature and is constituent of all living tissue. It exists in two distinct and allotropic crystalline forms, DIAMOND and GRAPHITE, and also in an amorphous form, charcoal.

Diamonds always occur in nature in alluvial deposits in the region of a certain kind of micaceous rock, called *itacolumite*. Diamonds have been prepared artificially by allowing carbon to crystallize from solution in molten iron or silver under a high pressure produced by rapid cooling of the iron. Graphite is commonly found in nature and may also be produced artificially.

Amorphous carbon is produced by heating substances which contain it, in the absence of air. The chief forms, as distinguished according to the process

of production, are charcoal, lamp-black, gas carbon and coke. The specific heat of amorphous carbon in the wood charcoal form is 0.241, and the specific gravity of pure charcoal is 1.57. It is tasteless and odorless; it is a good conductor of electricity. Pure sugar charcoal is used as a reducing agent. Many oxidizing agents convert amorphous carbon into complex soluble compounds, called *humic acids*, which may be further oxidized to produce such products as oxalic acid and mellitic acid. *See also CARBON, ACTIVATED; CARBON COMPOUNDS.*

**CARBON, ACTIVATED.** Common charcoal with its visible pores has long been used in taking up odors and impurities. Bone charcoal is the filtering medium for the removal of color from sugar solutions in the refinery.

The necessity of providing effective gas masks in the World War centered research attention upon charcoal. Methods of charring nutshells and of removing tarry materials by superheated steam brought into use an ultra-porous charcoal capable of retaining most poison gases, while allowing air to go through to the soldier's lungs.

Like all ultra-porous solids, such charcoal condenses many vapors into liquids in its capillaries, depending, in part, on smallness of capillary diameter, nearness to boiling point of liquid whose vapor is tested, and partial pressure of the vapor. (*See also ADSORPTION; CAPILLARY PHENOMENA.*)

However, another factor enters in. Since carbon is wetted better by hydrocarbons and related compounds than by water, it is evident that, from mixtures of vapors of water and hydrocarbons, it will preferentially adsorb and condense the hydrocarbons. The presence of water is no detriment. With silica gel the opposite is true.

Much activated carbon is now made from coal. It is effectively used in removing high-test gasoline from natural gas, taking up odors, recovering volatile solvents from air and as a catalyst for some reactions. Condensed liquids are removed from such carbons by steaming. *See also WOOD DISTILLATION; WOOD PRODUCTS.* H. N. H.

**CARBONADO**, called also "Carbon" or "Black Diamond," an opaque, tough, gray or black variety of DIAMOND which shows no cleavage. Because of its hardness and toughness it is much used in diamond drills and diamond-set lathe tools. *See also DRILLING.*

**CARBON ARC LAMPS:** In treatment of disease. *See LIGHT, ARTIFICIAL, IN TREATMENT OF DISEASE.*

**CARBONARI**, "charcoal-burners," an Italian secret society which originated early in the 19th century and spread from Naples over most of the peninsula. By revolutionary methods it sought to free Italy from foreign domination and to establish constitutional liberties. French Carbonari, unaffiliated politically, bore a part in the July Revolution of 1830. Carbonari first became active in southern Italy under the rule of JOACHIM MURAT (1808-15). Murat first supported and then attempted to exterminate them, but

they had gained too firm a foothold among the people to be dislodged. The Bourbon king, Ferdinand IV, made the same endeavor, but was obliged to yield to them and grant their constitution. Later, however, the movement was unsuccessful and apparently crushed in Naples and Piedmont, but broke out at other times and places until the Carbonari's place was taken by Mazzini's Young Italy Society in 1831.

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**CARBONATES AND BICARBONATES**, compounds usually white in color, of carbon dioxide ( $\text{CO}_2$ ) with a metallic oxide,  $\text{M}''\text{CO}_3$  or  $\text{M}'\text{CO}_3$ , according as the oxide contains one or two metal atoms. They occur in rocks formed under water, the most important being limestone ( $\text{CaCO}_3$ ), other forms being chalk and coral marble; dolomite (mixed carbonate of lime and magnesia); magnesite ( $\text{MgCO}_3$ ) and the carbonates of copper, iron and lead. (See also LIME; MARBLE.) The only carbonates soluble to any considerable extent in water are those of sodium ( $\text{Na}_2\text{CO}_3$ , soda) and of potassium ( $\text{K}_2\text{CO}_3$ , potash); the former, made on an enormous scale, is used in a variety of manufacturing operations. The other common carbonates are all sparingly soluble in water, but more soluble in water containing free carbon dioxide, owing to the formation, under these conditions, of the corresponding bicarbonate,  $\text{M}''(\text{HCO}_3)_2$  or  $\text{M}'\text{HCO}_3$ . This phenomenon is fundamental in the solution and redeposition of carbonate deposits, and probably in maintaining constant the proportion of carbon dioxide in the atmosphere; also it enters indirectly into the softening of hard water. Even in weak acid solutions, carbonates are decomposed with evolution of CARBON DIOXIDE. When heated sufficiently, they break up again into the metal oxide and carbon dioxide, as in lime-burning. The carbonates may be regarded as salts of carbonic acid ( $\text{H}_2\text{CO}_3$ ) in which both of the hydrogen atoms have been replaced by metal; in the bicarbonates only one of the hydrogen atoms has been replaced—for instance,  $\text{NaHCO}_3$ , bicarbonate of soda. The constitution and behavior of a bicarbonate solution is in time identical with that from the corresponding carbonate, if both are allowed to come to equilibrium with the atmosphere. J. Jo.

**CARBON BISULPHIDE**, a fluorescent liquid ( $\text{CS}_2$ ), having a chloroform odor when pure. Slight impurity gives it an offensive hydrogen sulphide odor.

Sp. gr.,  $1.256\frac{22}{4}^\circ$ ; boiling point,  $46.2^\circ \text{C}$ .; very inflammable. Carbon bisulphide reacts readily with inorganic bases to form thiocarbonic acid salts, with hydroxy compounds, as alcohol, to form zanthates, with amino-compounds, to form thiocarbamine compounds.

It is manufactured at very high temperature in closed iron pots, by the interaction of carbon and sulphur, the carbon being generally charcoal. The heat may be applied from fuel or by electricity. With electricity the mass of carbon, usually coke, is the resistor. The by-product is hydrogen sulphide, which is reacted with caustic soda. Carbon bisulphide is generally purified by distillation.

It is used principally as a solvent, generally mixed with a non-inflammable liquid; in rubber chemicals in the manufacture of thiocarbanilide and captax; in the viscose process for artificial silk. E. C. Br.

**CARBON BLACK**, an intensely black PIGMENT extensively used in PAINT, printing INK and RUBBER. It is almost all CARBON, with a small amount of volatile carbonaceous matter, and contains carbon monoxide, carbon dioxide, fixed oxygen and usually sulphur in combination with the carbon. It has great tinctorial power.

**CARBON COMPOUNDS**. Organic compounds for a long time were believed to contain a mysterious element of "life." Until the synthesis of naturally occurring organic materials, e.g., Wohler's preparation of urea in 1828, had helped to dispel such ideas, little was done to classify them from a scientific standpoint. Organic substances were considered as belonging to the ALIPHATIC COMPOUNDS, i.e., related to fatty substances, or as belonging to the AROMATIC COMPOUNDS, i.e., those possessing odor. Kékulé's assignment of a cyclic structure to BENZENE ( $\text{C}_6\text{H}_6$ ) and benzene derivatives (1865), however, gave rise to a means of classification which displaced the older distinctions. Compounds are now said to belong to the aliphatic series if they are derivatives of methane or its homologs, and to the aromatic series if they contain one or more benzene rings.

Each of the above two groups is subdivided into many smaller divisions, dependent upon the elements which occur in the compound and their structural arrangements within each molecule. Those substances which contain no other elements than carbon and hydrogen are called HYDROCARBONS, e.g., ethane,  $\text{CH}_3\text{CH}_3$ . When oxygen is present, in addition to carbon and hydrogen, the compound may be an ALCOHOL ( $\text{CH}_3\text{OH}$ ), ETHER ( $\text{CH}_3\text{OCH}_3$ ), ALDEHYDE ( $\text{CH}_3\text{CHO}$ ), KETONE ( $\text{CH}_3\text{COCH}_3$ ), ACID ( $\text{CH}_3\text{CO}_2\text{H}$ ), ESTER ( $\text{CH}_3\text{CO}_2\text{CH}_3$ ), PHENOL ( $\text{C}_6\text{H}_5\text{OH}$ ), CARBOHYDRATE ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), etc., depending upon the relation of the oxygen atoms to the carbon and hydrogen atoms. Nitrogen occurs with carbon and hydrogen in the AMINES. The presence of both oxygen and nitrogen in addition to carbon and hydrogen gives rise to the NITRO-COMPOUNDS, as well as to substances which are combinations of the simpler ones listed above, e.g., amino-acids, etc. The halogens, fluorine, chlorine, bromine and iodine, and also sulphur, phosphorus, various metals, etc., sometimes occur in organic compounds. Each class of compounds displays reactions which are more or less characteristic, and the study of these reactions and classes of compounds, all of which contain carbon, comprises what is known as organic chemistry. (See CHEMISTRY, ORGANIC.)

L. C. A.

**CARBONDALE**, a city in Jackson Co., southern Illinois, 100 mi. southeast of St. Louis, Mo. It is served by bus lines and the Illinois Central Railroad. The city lies in an important coal-mining region, and has clothing and glove factories and a railroad tie plant. The vicinity is a fertile agricultural district,



producing grain, fruit and vegetables. Carbondale is the seat of the Southern Illinois Normal University. The city was once the home of Gen. John A. Logan. A short distance south is Giant City State Park, an interesting geological formation, and Patterson Mineral Springs. Carbondale was settled in 1824 and incorporated in 1854. Pop. 1920, 6,267; 1930, 7,528.

**CARBONDALE**, a city in the anthracite fields of Lackawanna Co., Pa., situated on the upper Lackawanna River, 16 mi. northeast of Scranton; it is served by the Delaware and Hudson, the Erie, and the New York, Ontario and Western railways and by motor bus lines. The chief industry is coal-mining, but there are also machine and car shops, refrigeration plants and plants for the manufacture of mine machinery, silk and flour mills and a clothing factory. In 1929 the value of manufactures was about \$3,000,000; the retail trade amounted to \$8,194,145. Carbondale was settled about 1829 and chartered as a city in 1851. A monument commemorates the first coal mine opening in this vicinity in 1831. Pop. 1920, 18,640; 1930, 20,061.

**CARBON DIOXIDE**, the most important oxide of carbon, consisting of one atom of carbon united to two of oxygen,  $\text{CO}_2$ . It is a colorless, odorless gas, 1.53 times heavier than air, and can be condensed into a colorless liquid, kept under great compression in steel cylinders. If allowed to expand suddenly into air, the liquid cools off so considerably that part of it solidifies into a white snowy mass, **CARBON DIOXIDE SNOW**, which slowly volatilizes, remaining at the constant temperature of  $-79^\circ \text{C}$ . This is now used as a refrigerant. Carbon dioxide is formed when carbon is burned in air or oxygen, and is one of the principal combustion products of all organic matter. It is thus a characteristic constituent of air exhaled by animals and is produced in fermentation and rotting. It is present in the atmosphere in about 3 parts to 10,000 by volume, but is taken up again by plants which, by the process of photosynthesis, combine the carbon with water to form starch and other carbohydrates, liberating the oxygen. Carbon dioxide occurs free in volcanic fumes and in many mineral waters. Though not a poison, if present in quantities of more than 4%, it makes the air unfit to breathe, causing headaches and nausea, and in great concentration, due to lack of oxygen, death. Because it is heavier than air, it remains low on the ground. It is soluble in water, (forming a small percentage of the ions of *carbonic acid*,  $\text{H}_2\text{CO}_3$ ) and makes it slightly acid. In its salts, known as **CARBONATES**, the acid is much more stable, and occurs widely in nature as calcium carbonate or limestone. Industrially it is derived from limestone, or from the fermentation processes in breweries, and is used for the manufacture of soda and carbonated waters. *See also ASPHYXIA; GASES AND ATMOSPHERES, INJURIOUS.* W. J. L.

**CARBON DIOXIDE SNOW**, called "dry ice" by one manufacturer, is a form of carbon dioxide prepared by allowing compressed liquid carbon dioxide

to escape slowly from a tank into small moulds, and further compressed. (*See CARBON DIOXIDE.*)

Carbon dioxide snow is used in place of ice in refrigeration conducted on a small scale for transporting perishable food, as in packing ice cream, etc.

In medicine, carbon dioxide snow is employed in the treatment of certain skin affections, such as warts and moles. The snow is used in the form of a stick or pencil, which makes it easy of application. The cold destroys the tissue to which the carbon dioxide snow is applied, and this tissue sloughs, or drops away.

**CARBONIC ACID.** *See CARBON DIOXIDE.*

**CARBONIFEROUS PERIOD**, formerly considered the fifth and closing period of the **PALEOZOIC ERA** of geological history, and subdivided into the **MISSISSIPPIAN**, **PENNSYLVANIAN** and **PERMIAN**. These are now considered to rank as periods, and the Carboniferous is retained as a convenient inclusive term. These periods are marked by the formation of great coal deposits and the appearance of amphibians and reptiles.

**CARBONIZATION**, or destructive distillation of organic substances, the process of converting **COAL**, **LIGNITE**, **PEAT**, **WOOD** and similar organic materials into highly carbonaceous smokeless solid fuels, such as **COKE**, char or charcoal, by strongly heating the material in an oven or retort from which air is excluded. Modern retorts are connected with suitable equipment for collecting the combustible gas and volatile liquids that are formed as a result of chemical decomposition under the action of heat.

Coke has a strong cellular structure, due to partial fusion of the coal and the simultaneous evolution of gases in an early stage of the coking process, and to subsequent hardening of the porous mass on continued heating. All coals do not have this coking property. Non-coking coals, lignite, peat and wood do not fuse and become pasty under the influence of heat. The product of these materials is a char or charcoal.

Formerly, coal was coked in beehive ovens which wasted the gas and by-products, but now more than 90% of the annual output is produced in by-product ovens where the **GAS**, light oil, **TAR** and **AMMONIA** are recovered. The aggregate money value of these by-products is approximately three-fourths that of the coke. The principal use of coke is as a metallurgical fuel in blast furnaces and foundry cupolas (*see FOUNDRY PRACTICE*), but in recent years its use as a smokeless domestic fuel has been increasing rapidly.

A by-product coke oven consists of a rectangular chamber of refractory brick approximately 35 to 40 ft. long, 12 to 15 ft. high, 14 to 18 in. wide, and having a capacity of 12 to 16 tons of coal. Forty to 60 of these ovens parallel each other in a battery with rows of heating flues between. The coal is charged through holes in the top, and the coke is pushed out of the oven at the end, and quenched with water. (*See also DRY QUENCHING.*) Fifteen to 20 hours at a maximum temperature of  $1000^\circ$  to  $1200^\circ \text{C}$ . are required to coke a charge of coal.

Small ovens and horizontal or vertical retort plants are more generally used for the manufacture of city gas (*see* GAS MANUFACTURE), except where the demand is large enough to justify the large by-product coke ovens. German brown coals and lignite are carbonized at lower temperatures, not exceeding 650° C. Large scale experiments have been made—so far unsuccessful commercially—in the low-temperature carbonization of bituminous coal (*see* below). Low-temperature coke makes a more combustible smokeless domestic fuel, and the yield of tar is two to three times the quantity obtained at the higher temperatures.

The by-product recovery plant (*see* also COAL BY-PRODUCTS), connected with a battery of coke ovens or gas retorts, cleans the gas and recovers the tar and ammonia. The hot gas is drawn from the ovens by an exhaustor through a system of water coolers, tar extractors, ammonia and light oil absorbers, and finally purifiers, removing sulphur, cyanogen compounds, gum-forming substances and naphthalene. This final purification is employed only when the gas is sent through city distribution systems. A. C. F.

**High Temperature Carbonization** of bituminous coal is the process of heating it to a temperature exceeding 1500° F. to remove the volatile matter. The gas or vapor driven from the coal contains some constituents that are condensible, such as TAR, light oil and AMMONIA, while other constituents are non-condensable under ordinary conditions. These latter products form the gas used in industry and the home.

A ton of coal when carbonized will yield approximately 1,400 pounds of hard coke, 8 to 10 gallons of tar, 2½ to 3½ gallons of light oil and 10,000 to 12,000 cubic feet of gas. The gas contains about 550 to 600 BRITISH THERMAL UNITS per cubic foot.

**Low Temperature Carbonization** of bituminous coal involves heating to temperatures below 1200° F. to remove part of the volatile matter. The retorts for low temperature carbonization have, for most processes, been made of metal, but no standard type has been developed as in high temperature carbonization. The primary object of low temperature carbonization is to secure a smokeless fuel, semi-coke and primary tars which have a high tar-acid content. Low-temperature coke, which contains 10 to 15% of volatile matter, is an excellent domestic fuel, as it ignites easily and requires no forcing to maintain the fire. However, it is generally a soft coke which breaks and crumbles when subjected to even very slight handling. The tar made by this process is very fluid and, due to the low temperature at which it is made, is an uncracked *primary* tar. The gas contains about 1,000 to 1,200 BRITISH THERMAL UNITS per cubic foot.

A ton of coal when carbonized at low temperature will yield about 1,500 pounds of semi-coke, 20 to 25 gallons of tar, 2½ to 3½ gallons of light oil and 2,500 to 3,500 cubic feet of gas. R. L. B.; K. T.

**BIBLIOGRAPHY.**—Horace C. Porter, *Coal Carbonization*, New York, 1924; Frank M. Gentyr, *The Technology of Low Temperature Carbonization*, Baltimore, 1928.

**CARBON MONOXIDE**, a colorless, odorless, non-irritating gas, slightly lighter than air. Its chemical formula is CO, specific gravity 0.967 (air = 1), molecular weight 28.0, boiling point -190° C., melting point approximately -205° C., critical temperature -139° C.; is slightly soluble in water, burns with a blue-tinted flame. It is an asphyxiant, combines (reversible reaction) with hemoglobin more readily than oxygen and reduces capacity of blood for carrying oxygen to body tissues. The rapidity and severity of its action depends upon amount in the air breathed and duration of exposure, the effects being augmented by exercise. One per cent (volume) in air is fatal in 30 min., 0.3% produces dangerous illness in 30 min., 0.10% very discomforting symptoms in 30 min., 0.03% slight symptoms after several hours. (*See* also ASPHYXIA; GASES AND ATMOSPHERES, INJURIOUS.)

Carbon monoxide is produced by incomplete combustion of all carbon-containing materials, as coal, coke, charcoal, wood, natural and manufactured fuel gas; by action of steam or carbon dioxide on hot carbon; by thermal decomposition of certain organic liquids or vapors, as methanol. It is usually made in laboratories by heating mixture of oxalic and sulphuric acid, or by dropping formic acid into hot sulphuric acid. It occurs in gas and dust explosions, mine fires, products of combustion of explosives, blast furnace gas, metallurgical furnace gas, carbide furnace gas, coke-oven gas, WATER GAS, PRODUCER GAS, internal-combustion engine exhaust gas and as a product of incomplete combustion in gases from gas appliances, coal and wood stoves, salamanders, furnaces, boilers, and locomotives.

Carbon monoxide is a constituent of most manufactured fuel gases; recently used for synthesis of chemicals, as methanol; by its oxidation in stack gases (CO to CO<sub>2</sub>) we get the carbon dioxide for the manufacture of "dry ice" (*see* CARBON DIOXIDE SNOW); it is used in blast furnaces for reduction of metallic oxides to metals. W. P. Y.

**BIBLIOGRAPHY.**—U. S. Public Health Bulletin No. 195, on poisoning by carbon monoxide; U. S. Bureau of Mines, Miners' Circular No. 33, on detecting and analyzing carbon monoxide; J. W. Mellor, *Treatise on Inorganic and Theoretical Chemistry*.

**CARBONYL COMPOUNDS**, the term applied to aldehydes and ketones which contain the characteristic

carbonyl group,  $\text{—C=O}$ . ALDEHYDES have the carbonyl group located at the end of the carbon chain, while in KETONES it is on one of the middle carbons. Associated with the carbonyl group there may be atoms or groups of atoms, as  $\text{—CH}$ ,  $\text{—Cl}$ ,  $\text{—CO}_2\text{H}$ , etc., or there may be more than one carbonyl group in the molecule, thus extending them over the whole field of organic chemistry. Sulphur may be substituted for the oxygen to give thio-carbonyl derivatives. They are, especially the aldehydes, quite susceptible to oxidation, giving acids; and to reduction, giving corresponding alcohols. They react with  $\text{NaHSO}_3$ ,  $\text{NH}_3$ ,  $\text{HCN}$ , etc., to form additive compounds; with hydroxylamine to give aldoximes and ketoximes; and with

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**CARBON MONOXIDE**, a colorless, odorless, non-irritating gas, slightly lighter than air. Its chemical formula is CO, specific gravity 0.967 (air = 1), molecular weight 28.0, boiling point -190° C., melting point approximately -205° C., critical temperature -139° C.; is slightly soluble in water, burns with a blue-tinted flame. It is an asphyxiant, combines (reversible reaction) with hemoglobin more readily than oxygen and reduces capacity of blood for carrying oxygen to body tissues. The rapidity and severity of its action depends upon amount in the air breathed and duration of exposure, the effects being augmented by exercise. One per cent (volume) in air is fatal in 30 min., 0.3% produces dangerous illness in 30 min., 0.10% very discomforting symptoms in 30 min., 0.03% slight symptoms after several hours. (*See also* ASPHYXIA; GASES AND ATMOSPHERES, INJURIOUS.)

Carbon monoxide is produced by incomplete combustion of all carbon-containing materials, as coal, coke, charcoal, wood, natural and manufactured fuel gas; by action of steam or carbon dioxide on hot carbon; by thermal decomposition of certain organic liquids or vapors, as methanol. It is usually made in laboratories by heating mixture of oxalic and sulphuric acid, or by dropping formic acid into hot sulphuric acid. It occurs in gas and dust explosions, mine fires, products of combustion of explosives, blast furnace gas, metallurgical furnace gas, carbide furnace gas, coke-oven gas, WATER GAS, PRODUCER GAS, internal-combustion engine exhaust gas and as a product of incomplete combustion in gases from gas appliances, coal and wood stoves, salamanders, furnaces, boilers, and locomotives.

Carbon monoxide is a constituent of most manufactured fuel gases; recently used for synthesis of chemicals, as methanol; by its oxidation in stack gases (CO to CO<sub>2</sub>) we get the carbon dioxide for the manufacture of "dry ice" (*see* CARBON DIOXIDE SNOW); it is used in blast furnaces for reduction of metallic oxides to metals. W. P. Y.

**BIBLIOGRAPHY.**—U. S. Public Health Bulletin No. 195, on poisoning by carbon monoxide; U. S. Bureau of Mines, Miners' Circular No. 33, on detecting and analyzing carbon monoxide; J. W. Mellor, *Treatise on Inorganic and Theoretical Chemistry*.

**CARBONYL COMPOUNDS**, the term applied to aldehydes and ketones which contain the characteristic

carbonyl group,  $\text{—C=O}$ . ALDEHYDES have the carbonyl group located at the end of the carbon chain, while in KETONES it is on one of the middle carbons. Associated with the carbonyl group there may be atoms or groups of atoms, as  $\text{—CH}$ ,  $\text{—Cl}$ ,  $\text{—CO}_2\text{H}$ , etc., or there may be more than one carbonyl group in the molecule, thus extending them over the whole field of organic chemistry. Sulphur may be substituted for the oxygen to give thio-carbonyl derivatives. They are, especially the aldehydes, quite susceptible to oxidation, giving acids; and to reduction, giving corresponding alcohols. They react with  $\text{NaHSO}_3$ ,  $\text{NH}_3$ ,  $\text{HCN}$ , etc., to form additive compounds; with hydroxylamine to give aldoximes and ketoximes; and with

through only one of which, over a drawbridge, vehicles can pass. It is still inhabited. The Cathedral of St. Nazaire, within the walls, has a fortified Romanesque nave and a fine Gothic choir with magnificent stained glass windows.

Carcassonne has become a favorite goal for travelers. The Lower Town, laid out by St. Louis, is now a port on the Canal du Midi, with a prosperous trade in wine, and some industries. Pop. 1931, 34,921.

**CARDAMOM**, the aromatic, capsular fruit of several plants of the GINGER family, native to Eastern Asia, containing pungent spicy seeds used in medicine and in condiments. The true or official cardamoms of commerce are produced by a perennial herb (*Elettaria Cardamomum*), native to India and cultivated in Jamaica. This plant, which grows 5 to 10 ft. high, bears large leaves, purple striped flowers and small fruiting capsules, enclosing numerous angular seeds. Cardamoms of inferior quality are produced by several species of the closely allied genus *AMOMUM*.

**CARD AND TABLE GAMES**, the group of pastimes designed around playing-cards, and customarily played on a table or special board. Conventional card games may be divided into four classes: round games, in which any number of persons may join, such as (1), **POKER**, **MICHIGAN**, **HEARTS**, **VINGT-ET-UN**, **ONE HUNDRED**; (2), games requiring four players, among them **CONTRACT** and **AUCTION BRIDGE**, **EUCHRE**, **FIVE HUNDRED**, **WHIST**; (3), games for two players, or those which are more generally played by two only, such as **PIQUET**, **ÉCARTÉ**, **BÉZIQUE**, **CRIBBAGE**, **PINOCHLE**; and (4), games for one person, otherwise known as **SOLITAIRE**, of which there are many varieties, such as **CANFIELD**, **DOUBLE CANFIELD**, **NEVEREND**, and **MISS MULLIGAN**. Table games may be said to include that large number of amusements played on or around a table. In this large category are games played with cards, such as **TRENTE ET QUARANTE**, which requires a special table, and **BACCARAT**; other table games are **ROULETTE**, **FARO**, **PING-PONG**, and table-tennis, **KRIEGSPIEL**, all requiring special equipment. The simplest table games are sometimes known as board games, among them being **CHECKERS**, **CHESS**, **BACKGAMMON**, and **MAH JONG**.

**CARDENAS**, a city of Cuba in Matanzas Province on Cardenas Bay on the northern coast, about 41 mi. by rail east of Matanzas. It is well-built, with wide streets, good business houses, fine homes and many attractive squares. Big mango trees grow in almost every yard, and royal palms rise above the houses from inner courts, giving an oriental aspect to the city. A bronze statue of Columbus has been erected in one of the plazas, and there is a museum, in which is found a framed list of 72 American soldiers, the first to land in Cardenas. Its chief industry is the exporting of sugar; Cardenas has a good, though shallow, port. It was founded in 1828. Est. pop. 1930, 29,304.

**CARDIFF**, county town, city and seaport of Glamorganshire, south Wales, situated on the Taff, a

mile above its mouth, and 145 mi. west of London. Originally a Roman station, it was taken over by the Saxons and, subsequently, by the Normans, who built the castle now incorporated in the fine mansion of the Marquesses of Bute. Remains of a Dominican Priory and a Franciscan Friary, destroyed by Glendower, were uncovered in the last century, but of greatest antiquarian interest is the Perpendicular St. John's Church with its handsome tower. Cardiff is largely modern, having, in Cathays Park, a splendid group of administration buildings. There are over 300 acres of parks, and, among the educational foundations, is the University of South Wales. Since the cessation of Welsh coal production, Cardiff, once the largest coal-export port in the world, has greatly suffered. Its numerous industries include copper, iron and steel works, grain-mills and breweries. Pop. 1921, 219,580; 1931, 223,648.

**CARDINAL**, an ecclesiastical term, signifying a prince of the Catholic Church or highest dignity next to the pope himself. Cardinals are addressed as "Your Eminence" and their distinctive sign is a red hat. The word itself is derived from Latin and indicates an office on which events turn as on a hinge, and cardinals form the Sacred College which elects the pope. Their maximum number is 70 and usually there are vacancies to be filled. Cardinals are created by the pope and, as a rule, they are of episcopal status. Within their own body, however, they are divided into three ranks, namely, six cardinal bishops, 50 cardinal priests and 14 cardinal deacons. The high privileges of a cardinal are the result of an evolution that covers 15 centuries. The office originated in the Roman presbytery and to this day the cardinal bishops are appointed to dioceses adjoining Rome, while, by a picturesque formality, cardinal priests and deacons, though scattered throughout the world, are appointed to the care of parishes within the Eternal City. In 1931 the distribution of cardinals was as follows: Italian, 30; French seven; German five; American four; Spanish three; Polish two; Austrian two; Belgian, Brazilian, Canadian, Dutch, English, Hungarian, Irish, Portuguese, one each. In the United States in 1931 there were four cardinal archbishops, namely, Patrick J. Hayes of New York, G. W. Mundelein of Chicago, W. O'Connell of Boston and D. J. Dougherty of Philadelphia.

**CARDINAL** (*Richmondia cardinalis*), called also cardinal grosbeak, an exceedingly handsome song bird of the finch family common in the eastern United States. It is about 8 in. long with a conspicuous pointed crest, the male having bright red plumage, marked with black on the face and throat. The female is much duller in color. The cardinal feeds on insects, seeds and berries and nests in bushes, laying 3 or 4 grayish eggs speckled with brown. Because of its fine plumage and beautiful clear whistling song, the cardinal was formerly prized as a cage bird, but it is now illegal to keep it in captivity. Several closely related forms occur in the southern and western states and in Mexico. See also **GROSBEAK**.

**CARDINAL FLOWER** (*Lobelia cardinalis*), called also Indian pink, one of the most handsome of North American wild flowers, widely cultivated as an ornamental. It is a perennial herb of the LOBELIA family, found in moist low grounds from New Brunswick to Saskatchewan and southward to Florida and Texas. The upright stem, 2 to 4 ft. high, with oblong,



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CARDINAL FLOWER  
*Lobelia cardinalis*

dark green leaves, terminates in a long, narrow, leaf-bracted cluster of brilliant scarlet flowers, with a three-lobed lower lip and a slender upright portion, blossoming in late August or September.

**CARDINAL NUMBER**, a simple number used in counting, as *one, two, three, . . .* Upon these numbers the work in arithmetic hinges and hence the name, from the Latin *cardo*, a hinge. For the same reason we have cardinal points of the compass, the cardinal virtues, and the cardinals of a church. See ORDINAL NUMBER; NUMBERS, THEORY OF.

**CARDINAL VIRTUES**, the basic virtues of the Greeks as set forth by PLATO in his *Republic*.

This scheme is fourfold, the main virtues being wisdom for the intellect, courage for the heart, temperance for the appetites and justice for the soul as a whole. Of these, justice is the greatest, representing a harmony of the other virtues just as in society it stands for a harmony of interests. In his ideal society Plato would have the rulers excel in wisdom, the warriors courage and the husbandmen temperance. But all must be just.

**CARDING**, the textile manufacturing process for converting a confused mass of loose fibers into one or more untwisted strands of parallel fibers. In some cases carding removes a certain amount of dirt and short fiber. The mass to be treated is spread thinly by the machine over one or more cylinders covered with fine wire bristles, the cylinders revolving rapidly in close proximity to other surfaces similarly covered. The paralleling is accomplished by the resulting COMBING action. See COTTON; COTTON MANUFACTURE.

**CARDIOID**, a word, derived from the Greek *kardia*, heart, + *eidos*, form, referring to a heart-shaped curve. Its equation is

$$(x^2 + y^2 - 2ax)^2 = 4a^2(x^2 + y^2)$$

and is a special form of the epicycloid and of the limaçon. See CURVES.

**CARDOON** (*Cynara Cardunculus*), a coarse, thistle-like perennial herb, of the composite family,

closely related to the ARTICHOKE. The plant, native to southern Europe and northern Africa, is extensively cultivated as a vegetable, especially in continental Europe. It has run wild as a weed in various regions, notably in the pampas of South America, where it covers vast tracts. The edible portion, known as chard, consists of the blanched and crisped stalks of the leaves, used as a potherb. The root also is edible.

**CARDUCCI, GIOSUÈ** (1836-1907), Italian poet, critic and patriot, was born at Val di Castello, Versilia, July 27, 1836. From the first he represented the new Italy. In his *Hymn to Satan*, 1865, Satan is the symbol of science and freedom of thought, of liberation from superstition and dogma. His *Poesie*, 1871-72, and the *Odi Barbare*, 1877-89, express the thrill of living in a time of national independence and intellectual freedom. He exhorts the Italian people to throw off the "livery of the slave," to become worthy of their glorious past, and to wake up to their new responsibilities. In 1896 Italy celebrated the 35th anniversary of Carducci's professorship at the University of Bologna. He was concededly the national poet. The Nobel Prize in Literature was accorded to him in 1906. Carducci died at Bologna, Feb. 16, 1907.

**CAR DUMPER**, a device for unloading cars, mechanically. The car is run on a special section of track, where it is clamped to the rails, and the whole device rolled over so as to dump the contents of the car, generally into a hopper below.

**CAREW, THOMAS** (1595-c. 1645), English poet, was born at West Wickham, Kent, in 1595. He studied at Oxford, and spent some time in the service of Sir Dudley Carleton. He was made Gentleman of the Privy Chamber by King Charles I in 1628. Carew was one of the first of a group of lyrists classed as Cavalier poets. His masque, *Coelum Britannicum*, was published in 1634, but his *Poems* did not appear until after his death, about 1646.

**CAREX**, a very large genus of perennial grasslike plants of the sedge family commonly called SEDGES. There are about 900 species found chiefly in temperate and cool regions, of which more than 300 occur in North America. They grow chiefly in wet places with mostly triangular, solid stems and small, usually greenish flowers, the staminate and pistillate borne in separate spikes either on the same plant or on different plants. The fruit is a flattish or triangular achene. Although widely distributed and often exceedingly abundant, the plants of this immense genus are of little economic value. The herbage is usually harsh and innutritious, though that of a few species is utilized for hay and a few for making grass rugs. Many bear ornamental flowering spikes and a few are cultivated, as *C. Morrowii*, a native of Japan grown as a pot and border plant, and *C. comans*, of New Zealand, a tufted plant used for edgings.

**CAREY, HENRY** (c. 1692-1743), English poet, was born in London, about 1692. After a musical education, he followed the vocation of teaching while writing musical dramas and ballad operas. Chief among his productions are six cantatas, 1732, *A Hun-*



## CARICATURE

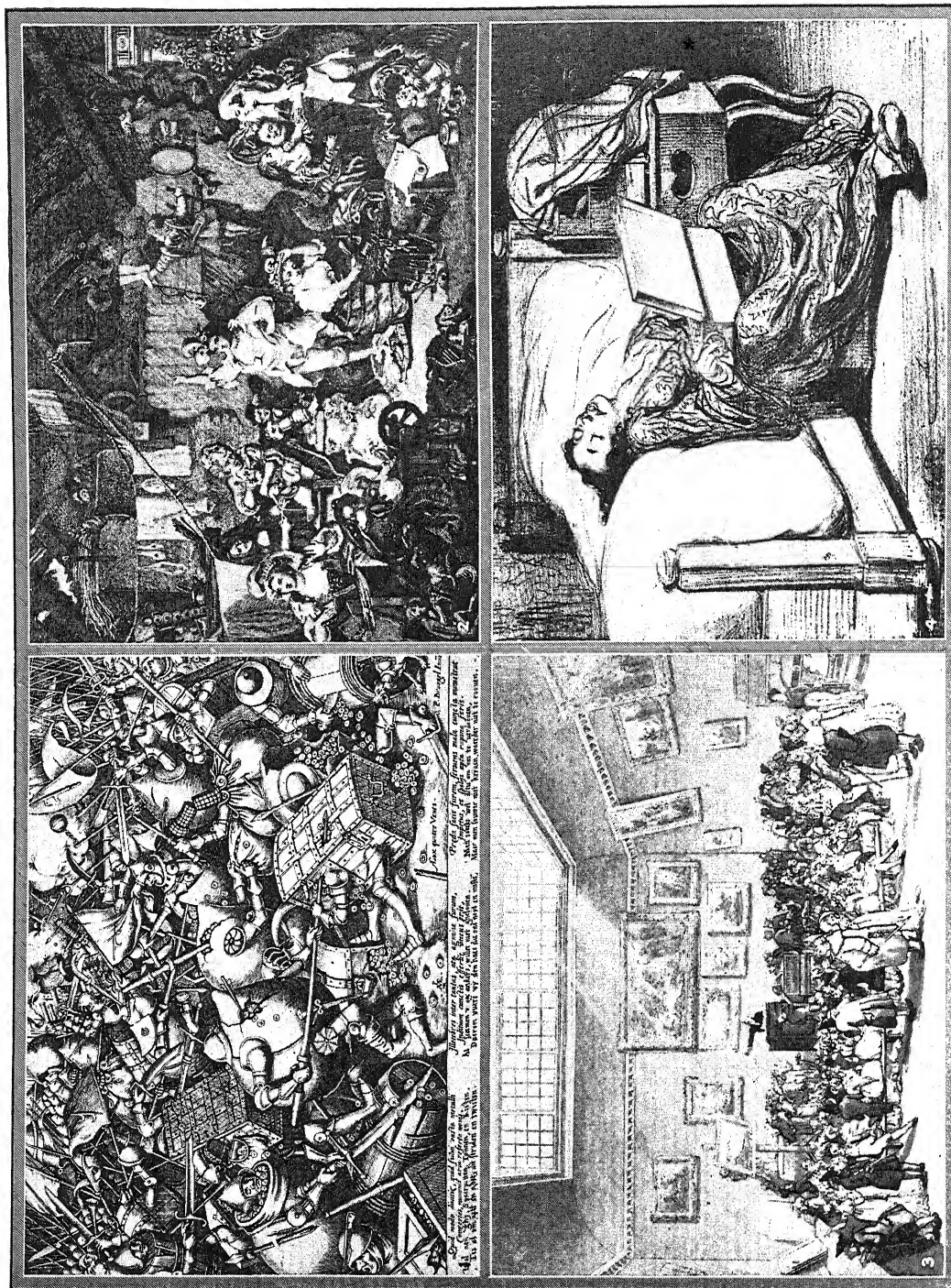


1. 2. 3. COURTESY METROPOLITAN MUSEUM OF ART

### EUROPEAN CARICATURE

1. Study of heads by Leonardo da Vinci (1452-1519). 2. "Till Death," from the series "The Caprices," by Francisco Goya y Lucientes (1746-1828). 3. "A Sufferer for Decency," by Thomas Rowlandson (1756-1827). 4. "A Pair of Connoisseurs," by Honoré Daumier (1808-79).

# CARICATURE



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## REPRESENTATIVE MASTERPIECES OF CARICATURE

1. "The Combat of the Tire-Lires and the Coffre-Forts," an engraving by Petrus a Merica after the painting by Peeter Brueghel the Elder (c. 1525-70). 2. "The Strolling Players," by William Hogarth (1697-1764). 3. "Christie's Auction Room," by Auguste Pugin (1762-1832) and Thomas Rowlandson (1756-1837), an illustration for R. Ackermann's "The Microcosm of London" (1808-11).
4. "La Musique," a caricature from a series on the Muses by Paul Gavarni (1804-66).

*dred English Ballads*, 1737, and the libretto of *The Dragon of Wantley*, 1737, with musical score by Lampe. Carey is generally considered the author of the British national anthem, *God Save the King*. *Sally in Our Alley* is also attributed to him. He died in London, Oct. 4, 1743.

**CAREY, HENRY CHARLES** (1793-1879), American economist, was born at Philadelphia, Pa., Dec. 5, 1793. His writings were chiefly devoted to the defence and propagation of the protectionist doctrine. He published *Principles of Political Economy* in 1837-40. He died at Philadelphia, Oct. 13, 1879.

**CARGO HANDLING.** See MATERIAL HANDLING.

**CARGO SHIP.** See SHIPS, TYPES OF.

**CARIB** or **CARIBAN**, an important tribe and linguistic stock of South American Indians. At the time of the discovery of America, the Carib were in the process of conquering and absorbing the ARAWAKAN tribes and held most of Venezuela, north of the Orinoco, the interior regions of the Guianas and south to the Amazon as well as the Lesser Antilles. The original home of the Carib was in the Matto Grosso region in the interior of Brazil, near the Bolivian border.

Columbus fought a battle with the Carib in 1493 on Santa Cruz in the Lesser Antilles. They were a fierce and warlike people who attacked the Arawak in the West Indian archipelago for the purpose of obtaining wives. They were cannibals—the very word “cannibal” being a corruption of Cariba. The island and sea-coast tribes were expert seamen and used sails on their canoes. The chief Carib tribes are the Galibi, Arecuna, Macusi, Rucuyenne, Apalai, Pianocoto, Makirifare and the Yanaperi. In recent times members of the Umaua tribe have settled in the region between the upper Naupes and the Yapura.

**CARIBBEAN SEA**, an arm of the Atlantic ocean, lying east of Central America. It is bounded on the south by South America, and partially enclosed on the north and east by the islands of the West Indies. On the northwest it is separated from the Gulf of Mexico by a line drawn between Cape Catoche, Yucatan, and Cape San Antonio, Cuba. The average depth of the Caribbean is 8,670 ft., the maximum depth 20,570 ft. The coastline is diversified by the Gulf of Honduras, the Mosquito Gulf and the Gulf of Darien. Since the opening of the Panama Canal the Caribbean Sea has become an important water highway, and from COLON trade routes radiate to all important American and European ports. Its southern coast was the famous Spanish Main where pirates and freebooters once preyed upon the merchant ships with their cargoes from the Orient.

**CARIBOU**, the American reindeer (*Rangifer*). The various species, grouped in two divisions, arctic and woodland caribou, are distributed throughout the Canadian arctic coasts and islands, the Hudson Bay region, Labrador, Newfoundland, and southward to Nova Scotia and Maine; also in the northern Rocky Mountains. The name, from an Indian language, was first applied to the large eastern or woodland species

(*Rangifer caribou*), now rare south of the St. Lawrence River. The treeless plains and islands from Hudson Bay north, and west to Great Slave Lake, are the home of the barren grounds caribou (*R. arcticus*), of smaller size than the woodland race and somewhat lighter in color of coat, which in these animals generally varies with species and season from warm brown to drab or whitish, with the under surfaces white. The slightly palmated antlers also differ in the various species, and are present in both sexes, though smaller in females. West of the Mackenzie River, and along the mountains southward into British Columbia, live more or less isolated varieties, allied to the woodland group, which are dark in color and excel eastern kinds in bodily size and massiveness of antlers.

The woodland caribou seek open pastures in summer, bear their young in June, but retire to the woods for winter shelter and hanging moss. Arctic caribou move with the changing seasons between the northern and southern parts of their range, migrating in enormous herds; constituting the principal resource of the Eskimos and Indians of the region for food, clothing, bedding and other means of life. In the autumn the whole population hunts, slaughtering the animals at favorable places, and preserving meat and hides. None of the American caribous have been domesticated; but they are popular and profitable game.

E. I.

**CARIBOU**, a town in Aroostook Co., northern Maine. It is situated on the Aroostook River, 450 mi. north of Boston, Mass., and is served by bus and truck lines and three railroads. There is a municipal airport. The chief crop of this region is potatoes; the local manufactures are shingles, starch and fertilizers. The town was founded in 1829. Pop. 1920, 6,018; 1930, 7,248.

**CARICATURE**, in graphic art, the use of exaggeration or distortion of physical characteristics for absurd or satiric effect. The more personal nature of caricature differentiates it from cartooning, a later development of the art of humorous representation, in which a person or cause is symbolized for didactic purposes. “Caricatura,” the Italian form of the word, from *caricare*, to load or charge, was Anglicized by Sir Thomas Browne in the 17th century, and in the next century Samuel Johnson incorporated it in his Dictionary.

Little is known of the art as practised by the Egyptians or Greeks but grotesque drawings unearthed at Pompeii and Herculaneum, and the mention by Pliny of comic portraitists indicate that intentional satire was practised by the Romans.

In the Gothic carving of medieval cathedrals the repeated representations of Reynard the Fox and the Devil and Death, personified as a sardonic skeleton, bear witness to the coarse materialism of the period. Hans Holbein (1498-1554) in his *Dance of Death* woodcuts, created an unsurpassed satiric morality.

Religious caricatures, first in the pagan mockeries of the early Christians, and later in the broadsheets of the REFORMATION, are among the most violent and venom-



ous. Fanned into flame by MARTIN LUTHER this type of "pious" attack passed through Germany and France to Holland. There, under Pieter Brueghel (1510-70), it reverted to medieval horseplay and macaber morality. From this tendency Continental caricature was rescued by the Lorraine engraver, Jacques Callot (1592-1635).

Having served the purposes of religion, caricature now took on a political temper, serving in England during the Civil War, and being wielded in Holland as a weapon against Louis XIV.

During the 18th century English caricature reached its height in the social satires of WILLIAM HOGARTH (1697-1764) whose engraved series of *A Rake's Progress* and *Marriage à la Mode* have never been surpassed. Spain produced Francesco Goya y Lucientes (1746-1828) whose series, *The Caprices and Disasters of War*, combine a unique mastery of plastic forms and weird imagination.

With the outbreak of the French Revolution a furious war broke out between such British political cartoonists as Gillray and Rowlandson and their less skilled but equally vitriolic French rivals. A little later, under the violently Republican journalist, Charles Philipon, French caricature took the lead, reaching its high water mark in the work of Honoré Daumier (1808-79). A draftsman of great skill and an audacious satirist, Daumier's 4,000 lithographs for Philipon's comic journal may be called an encyclopedia of caricature.

English caricature of the 19th century is marked by a refinement of earlier grossness, in the hands of such

best recruiting officer" on the Union side. Nast was the father of the present-day political cartoon. The inventor of such symbols as the Democratic "donkey" and the Tammany "tiger," the trenchancy of much of Nast's work has scarcely been surpassed. In the field of social satire the incisive and graceful characterizations of CHARLES DANA GIBSON (1867- ) have been followed by Peter Arno's bizarre caricatures (1902- ).

BIBLIOGRAPHY.—A. B. Maurice and F. T. Cooper, *The History of the Nineteenth Century in Caricature*, 1904; B. Lynch, *History of Caricature*, 1927.

**CARILLON**, a series of bells played by bell-ringers or by mechanical or electrical devices; or the tune produced by such a set of bells. Simple church chimes were common in northern Germany and the Low Countries throughout the 12th and 13th centuries. In England the traditions of the oldest society of bell-ringers, that of St. Stephen's of Bristol, trace back to 1574. Belgium and Holland possess the most noted carillons, but several in England are also famous, particularly those at Manchester, Catterstock and Bourneville.

Three methods are used in playing carillons. 1. The bells may be rung by hand, one bell-ringer usually operating three bell-ropes, in which case the bells are rung either in order ("rounds") or in a varied order ("change ringing"). 2. The bells may be pealed by mechanical means, in which event only the clappers move, controlled by wires connected with a set of levers or pedals. 3. Lastly, the clappers may be made to strike the outside or inside of the bells electrically, controlled by the keys of a console similar to an organ console.

The United States now has the largest carillon in the world, the Laura Spelman Rockefeller Carillon of the Riverside Church, New York City. Installed in 1930, this carillon has 72 bells, the largest of which is the great "Bourdon," weighing approximately 18 tons, which sounds low C. Five of the bells swing on ball bearings and are operated by electric motors. The others are stationary, having their clappers connected with the keyboard of the church organ, with a clavier and with a musical barrel operated by a clock.

**CARINA** (gen. *Carinae*), the keel, formerly a part of Argo, the Ship, now an independent constellation and one of the most brilliant in the sky. It contains CANOPUS, the second brightest star in the heavens, as well as a number of stars of the second and third magnitude. Among its variable stars Carinae is noteworthy; this is a CEPHEID of the fourth magnitude with a period of 36 days and, at average brightness, 10,000 times brighter than the sun. Eta Carinae, a faint star, situated in a knot of peculiarly shaped nebulous matter, forms the remains of an ancient Nova which has been fluctuating in brightness for more than 200 years and which in 1843 was almost equal to Sirius. It has now declined to the seventh magnitude. See STAR: map.

**CARLETON**, WILLIAM MCKENDREE (1845-1912), American poet, was born near Hudson, Mich.,



COURTESY METROPOLITAN MUSEUM OF ART

A THEATRICAL CANDIDATE  
A caricature by Thomas Rowlandson (1756-1827)

satirists as GEORGE CRUIKSHANK (1792-1878), John Leech (1817-64) and SIR JOHN TENNIEL (1820-1914), while among more modern practitioners there is Max Beerbohm (1872- ).

In the United States post Civil-War politics were attacked by THOMAS NAST (1840-1909), whose *Peace* cartoon was credited by Lincoln with being "the

Oct. 21, 1845. He was graduated from Hillsdale College in 1869, and in 1873 published *Farm Ballads*. The volume was tremendously popular, and was followed by other equally successful verse. Carleton founded *Everywhere*, a magazine, in 1894. His *Song of Two Centuries* appeared in 1902. He was one of the first American poets to give public readings from his own writings. *Over the Hill to the Poorhouse* is a favorite among his poems. Carleton died in Brooklyn, N.Y., Dec. 18, 1912.

**CARLETON COLLEGE**, a coeducational institution at Northfield, Minn., founded as Northfield College in 1866, by the Minnesota Conference of Congregational Churches. The present name was adopted in 1872 in honor of William Carleton of Charleston, Mass., an early benefactor. It has no denominational restrictions. The productive funds in 1931 were \$2,837,381. Buildings and equipment are valued at \$3,290,673. The library of 101,000 volumes includes the Ambrose W. Vernon Collection in Biography and the Cordenio A. Severance Library of Political Science and History. In 1931-32 there were 865 students and a faculty of 64, headed by Pres. Donald J. Cowling.

**CARLINVILLE**, a city in southwestern Illinois, the county seat of Macoupin Co. It is situated 40 mi. southwest of Springfield on the Chicago and Alton Railroad. The city is surrounded by extensive coal fields, and the coal industry is the principal local interest. Carlinville is the seat of Blackburn College Academy. The city was founded in 1829 and chartered in 1865. Pop. 1920, 5,212; 1930, 4,144.

**CARLISLE, JOHN GRIFFIN** (1835-1910), American statesman, was born in Kenton Co., Ky., Sept. 5, 1835. Largely self-taught, he was admitted to the bar in 1858 at Covington, where he became a prominent pleader. In 1859-61 he served in the Kentucky legislature, and maintained a neutral stand during the Civil War. He was lieutenant-governor of his state 1871-75, and a representative to Congress 1877-90. In Congress he took a prominent part in all tariff debates, and vigorously supported President Cleveland's demand for a downward revision of the tariff schedules. As speaker of the House, 1883-89, he gained distinction for his impartiality and his profound knowledge of parliamentary law. In 1890 he was appointed United States Senator to fill a vacancy, but resigned in 1893 to become Secretary of the Treasury under Cleveland. Carlisle declared himself for the gold standard in 1896, thereby antagonizing many of his former associates in the Democratic party. He left politics in 1897 to practice law in New York, where he died July 31, 1910.

**CARLISLE**, a city and the county town of Cumberland, England, lying about 50 mi. southwest of Newcastle. Originally British, Carlisle became Roman, and was later destroyed by the Danes. The castle, erected by William Rufus, for centuries bore the brunt of border-warfare and has a fine Norman keep and 14th century tower which imprisoned Mary, Queen of Scots, 1568. The great cathedral with its

Decorated east window also suffered from fire and war. The grandfather and mother of Woodrow Wilson were natives of Carlisle, and Sir Walter Scott was married in the cathedral. The modern city is a prosperous industrial and railway center, its interests connected with transport and textiles, the manufacture of which was introduced in 1750. Pop. 1921, 52,710; 1931, 57,107.

**CARLISLE**, a borough and county seat of Cumberland Co., Pa., in fertile Cumberland Valley about 19 mi. southwest of Harrisburg; it is served by the Pennsylvania and Reading railways. Industrially it serves an area of about 750 sq. mi. In 1929 the manufactured output, comprising chiefly, shoes, inner tubes, carpets and rugs, was valued approximately at \$13,000,000; the retail trade amounted to \$7,799,016. Agricultural products amount to about \$8,000,000; Dickinson College, oldest in the state, was founded in 1783.

Carlisle was founded in 1752. Indian warfare raged throughout the valley. It was named after Carlisle, Cumberland Co., England. "Molly Pitcher" of Revolutionary fame lived here and it was bombarded in the Civil War by the forces of Fitzhugh Lee. Three signers of the Declaration of Independence, George Ross, Thomas Smith and John Wilson, were born here. A Government reservation where British prisoners were confined in Revolutionary times, later the site of Carlisle Indian School, established in 1879 is now a United States army medical service school. A guardhouse built by Hessians captured during the Revolution still stands. Pop. 1920, 10,916; 1930, 12,596; about 1% were foreign-born, 7% colored.

**CARLISLE CATHEDRAL**, Carlisle, England, as it now stands, consists of only part of the original structure; but it is artistically interesting and has fine architectural detail. A large portion of the first Norman church was destroyed by fire, as was also the Early English choir of the 13th century. The nave was again partly demolished during the Civil War of the 17th century, and stones from the cathedral were used to repair the city walls. The present church consists of two bays of the Norman nave, the small transepts and the beautifully rebuilt east end, which constitutes the greater portion of the structure. Supported on Early English arches, the triforium and clerestory of the choir are



CARLISLE CATHEDRAL  
The east window

in the Decorated Gothic style. The special glory of the church is the Flamboyant window which fills the entire eastern wall, and which has been called "the grandest of its kind in England." Glass in the upper part of the window is old, but the lower lights are modern.

**CARLIST WARS**, a series of engagements fought in Spain after 1838 between the supporters of CARLOS



of BOURBON, who claimed the throne of his brother FERDINAND VII, formerly deposed by Napoleon, and the adherents of Carlos's niece Isabella. Allied with the Catholic power in Spain and secretly aided by the Pope, the Carlists triumphed until 1836, when the Legitimists and Liberals under General Espartero defeated them at Luchana. By 1839, the country was thoroughly pacified and the Carlists had taken refuge as exiles in France. A renewal of the war occurred in 1873 under the grandson of the first pretender, but was brought to a close by a second defeat of the Carlists in 1876.

**CARLOW**, the second smallest county of the Irish Free State, in the province of Leinster, is bounded by counties Kildare, Wicklow, Wexford, Queen's and Kilkenny and covers 221,424 acres. The ridge of Old Leighlin at the edge of the coal region and, to the southeast, the wild, granitic mountain range of which Mt. Leinster, 2,610 ft., is highest, offer bold contrast to a rolling countryside. Waterway is afforded by the Barrow, and to the eastward, by the Slaney, which, however, is not navigable its entire length. Many early relics are found in the county. The population is largely engaged in stock-raising. There is, however, a flourishing agricultural trade throughout the county. General manufacture is negligible, except in the splitting of local sandstone. Pop. 1926, 34,476.

**CARLSBAD** (Czech *Karlovy Vary*), a Czechoslovak city in Bohemia, situated in a narrow valley surrounded by wooded hills. According to tradition, Emperor Charles IV discovered the famous Carlsbad springs in 1347 while hunting deer, but records show that they were used much earlier. The water is used for drinking and bathing. Carlsbad has fine streets and parks, Catholic, Protestant Anglican and Russian churches and a synagogue. The various fine colonnades, the casino, and the large Kaiser Bath are noteworthy. There is considerable industry, principally in the manufacture of china. Visitors annually average 50,000. Most of the inhabitants are German. Pop. 1921, 19,480.

**CARLSBAD**, a town in southeastern New Mexico, the county seat of Eddy Co. It is situated on the Pecos River, 230 mi. southeast of Albuquerque and is served by the Santa Fé Railroad. Wool, cotton, alfalfa and livestock are shipped from the city, and it has cotton gins and a cotton-seed oil factory. The vicinity benefits by the U.S. Government Irrigation Project. The nearby lakes and mineral springs are of great interest to tourists, and about 30 mi. from the city is CARLSBAD CAVE National Monument, with its enormous cavern. Pop. 1920, 2,205; 1930, 3,708.

**CARLSBAD CAVERNS NATIONAL PARK**, in southeastern New Mexico, contains the largest series of underground caverns yet explored in the world. An area of 1.12 sq. mi., previously a national monument under the administration of the Department of the Interior, was given park status May 14, 1930 pending investigation to determine how much of the possible 193 sq. mi. of territory should be included

in order to protect the caverns adequately. Their full extent is as yet unexplored.

The limestone decorations here are unsurpassed. In the Big Room, an enormous chamber 4,000 ft. long with a maximum width of 625 ft. and height of 300 ft., the stalactites range from almost needle-like proportions to huge chandeliers. The stalagmite formations vary from tiny hummocks to the Giant Dome, 62 ft. high and 16 ft. in diameter, which scientists give an estimated age of 60,000,000 years.

The cavern was discovered by Jim White, a cowboy. Originally, it was called Bat Cave because some 3,000,000 bats emerge from the natural opening every evening at sundown during the summer months, causing a "smoke" lasting from two to three hours.

Visitors have access to approximately 7 mi. of the caverns and other portions are being opened. The park is 30 mi. southwest of the city of Carlsbad, N.M., which is on a U.S. Interstate Highway and the Atchison, Topeka, and Santa Fé Railroad.

**CARLSBAD DECREES**, a series of reactionary measures adopted by German rulers called together by Metternich at Carlsbad in 1819, and later adopted by the Diet of the Germanic Confederation. At first adopted for five years, they were repeatedly renewed and made the legal basis for the suppression of liberalism in the Germanies for a generation. They provided for a vigorous censorship of the press, stifling all expression of opinion on political matters, and the appointment of a special official at each university to supervise and watch over the conduct of professors and students and to give a salutary direction to the instruction. They were to make regular reports and to note particularly any departure from accepted principles. Any professor reported as propagating "harmful doctrines hostile to the public order, or subversive to the existing governmental institutions" was to be summarily dismissed. Teachers and students so dismissed were not to be admitted at other universities. The Students' Union (*Burschenschaft*) was dissolved, as utterly wrong in principle, and special provisions made against its reorganization under another name.

Under these repressive measures, many of the heroes of the War of Liberation were persecuted as demagogues. Fichte's *Address to the German Nation* was not allowed to be republished, Arndt was dismissed from his professorship, while Turnvator Jahn who had done such valiant service in training and drilling the youth of Germany for the struggle against Napoleon was thrown into prison.

**CARLSTADT**, a manufacturing borough of Bergen Co., N.J., situated on sharply rising ground overlooking the tidal flats of the Hackensack River, 8 mi. west of New York City. It is served by the Erie Railroad, electric trolleys and numerous motor bus lines. Local industries include the manufacture of electrical equipment, buttons, cigars, textiles, chemicals, and wax products. The radio transmitting station of WHAP is located here. Carlstadt received its charter as a borough in 1894. Pop. 1920, 4,472; 1930, 5,425.

**CARLYLE, THOMAS** (1795-1881), Scottish author and historian, was born in Ecclefechan, Dumfriesshire, Dec. 4, 1795, the son of a poor farmer. As a boy he showed an eager desire for knowledge, and it was decided that he should enter the ministry. While studying at the University of Edinburgh he evinced that rebelliousness against outworn, dead creeds which was later to become a dominant note in all he wrote. Carlyle was graduated but very soon gave up the ministry; for a time he taught school, meanwhile reading widely in German, French and English. In 1821 he emerged from a spiritual crisis to "an immense victory," to what he believed was a secure, high point in life from which he could survey the human struggle "pitying the religious part . . . and indignant against the frivolous." It was perhaps the indignation that was to keep him from ever achieving in himself the serenity which he so admired in GOETHE. In 1822 Carlyle met and fell in love with Jane Baillie Welsh, a brilliant, well-bred girl whom he married in 1826. The marriage resulted in an almost continual clash of temperaments, and has been the subject of much discussion and controversy. The Carlyles lived briefly at Edinburgh, then in 1828 moved to Craigenputtock, a lonely farm belonging to Mrs. Carlyle. Here *Sartor Resartus* was finished, and here Carlyle received a memorable visit from RALPH WALDO EMERSON. In 1834 the couple moved to Chelsea, London, settling permanently at what is now No. 24 Cheyne Row. Mrs. Carlyle died at this address in 1866, and Carlyle died there Feb. 4, 1881.

*Sartor Resartus*, 1833-34, Carlyle's first notable publication, is a satire on society, on its concern with appearances only, its deadly hypocrisy, its complete lack of spiritual direction; the satire is perhaps too strained, too passionate at times to be of the highest order, though many critics consider the "Clothes Philosophy" Carlyle's finest work. More generally regarded as his masterpiece is *The French Revolution*, published in 1837. It is one of the most graphic histories ever penned, a history that reveals situations and people in terrific lightning flashes, thundering its denunciation of social and political evils, and it soon made Carlyle famous. *Heroes and Hero-Worship*, 1840, composed of a series of lectures on Odin, Mahomet, Dante, Shakespeare, Luther, Cromwell and Napoleon, afforded Carlyle further expression for his conviction that men must recognize and follow greatness, and only greatness, in their leaders. *Chartism* had already appeared in 1839, and the problem of "might and right" was further handled in *Past and Present*, 1843. Carlyle's next work was *The Life and Letters of Oliver Cromwell*, 1845, a magnificent tribute to Cromwell's greatness as a leader. Two minor works, *Latterday Pamphlets*, 1850, and the excellent *Life of Sterling*, 1851, followed, and then in 1858 appeared Carlyle's last great work, *The History of Frederick the Great*. In 1866 Carlyle began his *Reminiscences*, published by his literary executor, J. A. Froude, with ill-advised haste in 1883. In his last years Carlyle enjoyed the friendship of his most notable contempo-

raries, but was debarred from happiness by his chronic dyspepsia and inveterate pessimism.

Carlyle's reputation has suffered greatly since his death. It is doubtless true that his greatest quality—his intense, prophetic vision of life—was also the source of his principal weakness—his failure to find in himself the ultimate fine adjustment that would have made his vision clear and given it authenticity. He stands, therefore, a man of genius, but one whose spirit was too troubled, too turbulent to reach its highest effectiveness. As a prose writer he strove for and achieved a style so graphic that his words often overshoot their mark; magnificent in its vigor, it may however seem at times needlessly vehement, or even tiresome. Yet Carlyle remains an inspiring figure, for he was a man who struggled with almost god-like faith and energy to open men's eyes and to create in them a new vision. See also ENGLISH LITERATURE.

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**CARMAN, WILLIAM BLISS** (1861-1929), Canadian poet, was born at Fredericton, N.B., Canada, Apr. 15, 1861. He graduated from the University of New Brunswick in 1881, studying afterward at the universities of Edinburgh and at Harvard. He was successively on the staffs of *The Independent*, *Current Literature* and *The Atlantic Monthly*. Carman's title to fame, however, rests upon his poetry which reflects his spontaneous delight in nature. His three volumes of *Songs from Vagabondia* contain lyrics by RICHARD HOVEY. Other collections of Carman's poems are *Pipes of Pan*, *Later Poems*, 1921, and *Wild Garden*, 1929. Among his prose essays are *Kinship with Nature*, 1904, and *Poetry of Life*, 1905. Carman died June 8, 1929, at New Canaan, Conn.

**CARMARTHEN**, the capital of Carmarthenshire, Wales, situated above the Towy, about 175 mi. northwest of London. A Norman castle, occupying a Roman site, together with a 12th century parish church, was the nucleus of the medieval town; it was continually being attacked by the English and the people of the surrounding hills. Merlin, where Sir Richard Steele died, is associated with Carmarthen. In 1747 the first Welsh iron-smelting works were established in the town, and these persisted until 1900. To-day, Carmarthen has a modern aspect and is an agricultural and fishery center. Pop. 1921, 10,011; 1931, 10,310.

**CARMEL-BY-THE-SEA**, a town in Monterey Co., middle California, situated on the Pacific Ocean, 4 mi. south of Monterey. Carmel-by-the-Sea is a well-known colony for artists and writers. Father Junipero Serra founded a mission here shortly after 1770 and he is buried in the Mission Church. Pop. 1920, 638; 1930, 2,260.

**CARMELITES**, members of the Order of Our Lady of Carmel, a mendicant order of Catholic monks established in 1156 on Mount Carmel, Pales-

time, by St. Berthold. The habit they wear has also caused them to be called "White Friars." The grottoes in the Mt. Carmel Range have been the abode of hermits from the earliest Christian centuries, and it was from the survivors of these anchorites that the first membership of the order was drawn. Their monastery is situated, like a lighthouse, 560 ft. above the sea, at the northwest extremity of the range near "Elijah's Grotto," which forms the crypt of the church. Because St. Louis visited the monastery in 1252 he has sometimes erroneously been called its founder. The Carmelites suffered much persecution from adjacent tribes. Their monastery has been a mosque and a hospital and was destroyed in 1821 by Abdallah Pasha, but was later rebuilt. The first rule of the order required vows of poverty, abstinence from meat, seclusion, silence and labor, but this rigidity was mitigated by Pope Innocent IV (1243-54) and by Pope Eugenius IV in 1431. Those communities which kept the stricter rule were called Observantines, the others, Conventuals.

**CARMEN**, an opera in four acts by **GEORGES BIZET**, libretto founded on Prosper Mérimée's romance of the same name by Henri Meilhac and Ludovic Halévy; première, Paris, 1875, London, 1878, New York, 1879. Destined to become perennially popular, this last work of the French composer was paradoxically greeted by a hostile world. Discouraged by the dismal failure of its first production, Bizet died three months later.

A gypsy and an incorrigible flirt, Carmen has set her tempestuous heart on Don José, a handsome young officer of the guards stationed near the cigarette factory in Seville where she works. At first he steels himself against her charms; but the flaming cassia-flower which she one day tears from her bodice to fling with a challenge at his feet is a challenge he cannot resist. He dismisses thoughts of Micaela to whom he is pledged. When, on the same day, Carmen stabs one of her fellow-workers and appeals for protection to Don José, he aids her to escape and makes a tryst with her at a tavern. For this he suffers two months' arrest, and by the time he reaches the tavern Carmen has Escamillo, a handsome bullfighter, under her spell. Don José is tempted to leave, but Carmen's taunts draw him on and, in order to escape punishment for desertion, he follows her to the seclusion of a gypsy camp. There Carmen quickly tires of his love, Micaela brings news of his dying mother, and so, swearing to wreak his revenge on Escamillo with whom he has already had one duel, Don José departs for his home. But a great bullfight is soon to take place, and Escamillo, the famous toreador, has invited his friends to attend. Finding Carmen at the entrance to the arena Don José stops her, accusing her of having given her heart to Escamillo, and confronting her in a frenzy with a drawn knife. Although previously warned of her danger she laughs at him, joining in the huzzas for Escamillo whose victory is being proclaimed by the assembled throng. The jilted Don José plunges his knife into her back, and her long-drawn shriek mingles with the rising tumult of the crowd.

**CARMONA, TRAGOSO** (1869- ), Portuguese general and statesman, born at Lisbon, Nov. 24, 1869. Trained as a soldier, Carmona was made a general in 1922, and Minister of War in 1923. In May 1926, he took part in the revolt of Gen. da Costa and soon thereafter became Minister of Foreign Affairs. On July 9, he carried out a successful coup d'état against da Costa, seized power, became president of the Council of Ministers and later president of the Republic. In the elections of Mar. 1928, he was confirmed in this position, and began carrying on the government in the rôle of a constitutional dictator.

**CARNARVON, GEORGE EDWARD STANHOPE MOLYNEUX HERBERT**, 5th Earl of (1866-1923), British Egyptologist, was born at Highclere, Berkshire, June 26, 1866. He was educated at Eton and Cambridge and early evinced interest in Egyptology. In 1906 he joined Howard Carter, former inspector of antiquities at Thebes, in excavations near there, beginning thus the series of important discoveries which, though interrupted by the World War, he was still engaged in at the time of his death. The early excavations uncovered tombs of the XII and XVIII Dynasties, while work resumed at the end of the war disclosed the Tomb of Tutankhamen (1921-24). The burial chamber of the tomb was opened Feb. 16, 1923. Lord Carnarvon died of erysipelas, resulting from a mosquito bite, at Cairo, Apr. 5, 1923.

**CARNARVON**, a seaport and county town of Carnarvonshire, Wales, lying between the Menai Straits and the mouth of the Seiont, about 68 mi. west of Chester and 205 mi. northwest of London. Situated near a Roman-British site, its castle, imposing and well-preserved, was long but erroneously credited with being the birthplace of EDWARD II, first Prince of Wales. The 13th century town walls still are standing. A tourist center to-day, Carnarvon, with its ancient narrow streets, simple public buildings and small harbor, has scant manufactures. Pop. 1921, 8,307; 1931, 8,469.

**CARNATION** (*Dianthus Caryophyllus*), called also clove pink, a member of the Pink family, a half hardy perennial native to southern Europe. For more than 2,000 years it has been a popular garden flower, though it began to approach its modern form only about the beginning of the 16th century when European gardeners produced countless varieties.

As an outdoor flower it is still popular in Europe, but much less so in America; on the other hand it is less grown in European greenhouses, whereas in America the only greenhouse flower that outranks it is the rose. So important had it become that in 1891 the still active American Carnation Society was organized.

The perpetual blooming form grown commercially in America originated about 1840 with M. Dalmas, a French gardener. This has been greatly improved by many American florists, especially by the late Frederick Dorner who during more than 20 years made

thousands of crosses and ultimately developed plants distinguished for great diversity of color from white to deep red and pale yellow, easy growing habits, prolificacy of flowers and wide adaptability to commercial purposes. Since its introduction to America about 1,500 varieties have been developed, the quality improved, the length and strength of the stems greatly enhanced, and the size of the individual flowers increased to more than 4 in. across in well-grown specimens.

For commercial purposes, millions of plants are grown annually from cuttings, preferably taken from blooming stock and rooted in sand during winter. When well rooted, in about four weeks, they are planted in 2-inch flower pots and later shifted to larger sizes to prevent their becoming pot-bound, stunted and therefore inferior as producers of flowers.

When weather in spring becomes settled they are planted out of doors in rich sandy loam, cultivated and kept growing steadily until midsummer. They are then transplanted to bench beds or solid soil beds in greenhouses and kept as cool as the weather will permit until autumn when the temperature can be controlled more easily, about 50° at night and 60° during the day. Flower cutting usually begins in early autumn and continues until May or June of the following year.

Among several other types of carnations the most deservedly popular in America are the Marguerite varieties, producing a wide range of colors in a few weeks from seed sowing, and Chabaud, starting to bloom in about five months and producing an indefinite profusion of fragrant double flowers in red, yellow, rose, scarlet, pink and white. If protected during winter plants of these two groups will blossom again during the following year.

M. G. K.

**CARNEGIE, ANDREW** (1835-1919), American steel manufacturer, was born in Dunfermline, Scotland, Nov. 25, 1835. His father, proprietor of a small hand-loom establishment, immigrated in 1848 to the United States. The son obtained a job as bobbin-boy in a cotton-factory at Allegheny City, Pa., and although not yet 14, he showed qualities of intense industry and application. After rapidly mastering telegraphy, he became an operator on the Pennsylvania Railroad. In 1860 Carnegie began to make his characteristically shrewd investments. Upon the outbreak of the Civil War, he was given charge of all military railroads and telegraphs in the east. In 1862 Carnegie saw that iron railroad bridges would in time supplant wooden structures, and to supply this growing demand he organized the Keystone Bridge Works. After building the first iron bridge across the Ohio, he began the production of the iron needed for his bridges. As a further step, he began to buy iron-ore fields, thus laying the foundation of his wealth. He organized the Union Iron Mills, and in 1888 acquired controlling interest in his largest competitor, the Homestead Steel Works, where serious labor troubles occurred in 1892. Carnegie also obtained stock in seven other mills in the Pittsburgh (Pa.)

vicinity, together with lake steamers to carry ore to his mills. His diverse industrial interests were merged in 1899 into the Carnegie Steel Co., which was reorganized by J. Pierpont Morgan as the United States Steel Corporation. After his retirement Carnegie gave his time to establishing the trusts for educational and social purposes, which bear his name (*see* CARNEGIE TRUSTS). He wrote *Empire of Business* (1902) and *Problems of To-day* (1908), beside other books not connected with commercial activities. He died at Lenox, Mass., Aug. 11, 1919.

**CARNEGIE**, a borough in Allegheny Co., southwestern Pennsylvania, in the valley of Chartiers Creek, six mi. southwest of Pittsburgh. It is served by three railroads. There are coal mines here, and steel, glass and lead plants. The manufactured output, 1929, was worth \$21,989,976. In 1929 the retail business amounted to \$6,269,363. The borough was formed by the union of Chartiers and Mansfield in 1894. Pop. 1920, 11,516; 1930, 12,497.

**CARNEGIE INSTITUTE OF TECHNOLOGY**, a division of the Carnegie Institute, was established in 1900 by funds given the city of Pittsburgh, Pa., for that purpose by ANDREW CARNEGIE. It was opened in 1905 as a privately controlled non-sectarian institution for men and women. The institute comprises four colleges: The Margaret Morrison Carnegie College for Women, College of Fine Arts, College of Engineering, and College of Industries. Instruction in the usual college subjects is given in the Division of General Studies. Evening courses are offered in all the colleges except the Margaret Morrison Carnegie College. The institute had productive funds in 1931 of \$16,383,000. In addition to the Carnegie Library of Pittsburgh which adjoins the campus, there are several branch libraries. In 1931-32 there were 2,521 full-time students and a faculty of 294, headed by Pres. THOMAS S. BAKER.

**CARNEGIE INSTITUTION OF WASHINGTON**, an agency for scientific research founded in Washington, D.C., by Andrew Carnegie in 1902 (chartered by Congress, 1904). Total endowment of \$30,000,000 includes a gift of \$5,000,000 from the Carnegie Corp. of New York. The Institution was established to encourage "investigation, research and discovery, and the application of knowledge to the improvement of mankind" under the direction of a board of 24 trustees. Experience and progress have resulted in the establishment of major researches in 10 divisions and departments, namely: Embryology, with laboratories in the Hunterian Building of Johns Hopkins Medical School; Genetics, with the Eugenics Record Office, located at Cold Spring Harbor, Long Island; Nutrition Laboratory, adjacent to the Harvard Medical School in Boston; Tortugas (Florida) Marine Biological Station; Geophysical Laboratory in Washington; Terrestrial Magnetism, also in Washington, in connection with which the famous non-magnetic ship *Carnegie* was operated; Meridian Astrometry, at the Dudley Observatory in Albany; Mt. Wilson Observatory, with its 100-inch telescope, in Pasa-

dena, Cal.; Historical Research, comprising studies in aboriginal American history, including Maya archaeology, U.S. history, and history of science; and Plant Biology, with a central laboratory at Stanford University, Cal.

The Institution attempts to advance fundamental research in fields not normally covered by the activities of other agencies, and to concentrate attention upon specific problems with the idea of shifting attack from time to time to meet more pressing needs of research as they develop with increase of knowledge. Publications are constantly being issued, designed to present in technical and also in more readable form the results of original investigations conducted by the Institution. More than 600 volumes have thus far been issued in a series of monographs, and other publications include the annual year book, lecture series, news release, and descriptions of exhibits which are held annually in Washington.

**CARNEGIE TRUSTS**, a group of philanthropic organizations founded and endowed with approximately \$235,000,000 by ANDREW CARNEGIE.

#### TRUSTS IN THE UNITED STATES

**Carnegie Corporation of New York.** This was established in 1911, for the advancement and diffusion of knowledge and understanding among the people of the United States, Canada and the British Colonies, through the support of educational and scientific research, publications of professional and scholarly associations, fine arts education, adult education and library service and training. Its endowment is approximately \$135,000,000, of which \$10,000,000 is applicable to enterprises in Canada and the British Colonies. The income from the capital only is used.

**Carnegie Endowment for International Peace.** This was established in 1910, "to hasten the abolition of international war," by promoting scientific investigation and study of causes of war and methods to prevent it; aiding in development of international law; educating public opinion; cultivating friendly feelings between inhabitants of different countries, and maintaining organizations to accomplish this. The income from \$10,000,000 is available.

**Carnegie Foundation for the Advancement of Teaching.** This was established in 1905 to provide retiring allowances for teachers and pensions for their widows in universities, colleges and technical schools in the United States, Canada and Newfoundland, and to provide for educational inquiry. To Carnegie's donations of \$15,000,000, the Carnegie Corporation has added \$12,000,000. The original free pension system could provide for only a limited number of teachers, and the foundation after an exhaustive study of pensions established the Teachers Insurance and Annuity Association, through which any university or college teacher may obtain annuity and insurance contracts at net rates. On September 30, 1930, the total number of such contracts was 14,919, and the amount of the annual annuity \$13,662,000, and of insurance \$36,662,000. The foundation distributed during the year

ending June 30, 1930 \$1,544,000 in retiring allowances for teachers and pensions for their widows, a total since 1905 of \$20,361,000. In 1913 Carnegie added to the foundation a Division of Educational Inquiry, giving \$1,250,000 for this purpose.

**Carnegie Hero Fund Commission.** This was established in 1904 to make annual awards from the income of \$5,000,000 in recognition of heroic acts in the United States, Canada and Newfoundland. Medals are awarded to the heroes and financial assistance given when needed for education, purchase of homes, liquidation of debts or pensions for dependents.

**Carnegie Institute of Pittsburgh.** This was founded in 1896 and conducts an Institute of Technology, a fine arts museum, music hall, natural history museum and public library, including a library school. Total gifts for these activities amounted in 1930 to \$27,000,000.

**Carnegie Institution of Washington.** This was founded in 1902 to "encourage in the broadest and most liberal manner, investigation, research and discovery, and the application of knowledge to the improvement of mankind." The gift of Carnegie of \$22,000,000 has been supplemented by \$5,000,000 from the Carnegie Corporation of New York. Appropriations for 1930 included \$1,221,309 for research and \$97,010 for publications.

#### TRUSTS IN THE UNITED KINGDOM

**Carnegie United Kingdom Trust.** This was established in 1916 with an endowment of \$10,000,000 for the improvement of the well-being of the masses of people in Great Britain and Ireland. The program laid out for 1931-35 emphasized support of children's play centres, libraries, rural developments, adult education and public museums.

**Carnegie Trust for the Universities of Scotland.** This fund of \$10,000,000 was established in 1901 for academic buildings, equipment, endowment and scholarships.

**Carnegie Hero Fund Commissions.** A total income from \$5,000,000 is available for awards in Great Britain and Ireland, France, Germany, Italy, Belgium, Denmark, Netherlands, Norway, Sweden and Switzerland, as in the United States. M. R.

**CARNELIAN**, a variety of red chalcedony much used for ornament. Carnelian occurs as a nodular incrustation in crevices of volcanic rocks. It is translucent, of medium hardness, and retains a good polish. The most valuable stones are deep blood red, and when free of flaws are termed by lapidaries "male" carnelians, the much commoner light red or honey-colored pieces being classed as "females." The finest carnelian comes from India, where native experts often intensify the color by slow baking in the sun. Carnelians of good quality come from Siberia, Queensland, Tampa Bay, Florida, and Nova Scotia. South American agate, artificially colored, is marketed as carnelian. Cameos are sometimes cut in red carnelian on which an opaque white surface has been chemically induced.



**CARNIVAL**, a period of festivity. The word is derived from the Latin *carnelevamen*, meaning a release from the flesh. In Europe, especially in the Roman Catholic countries, the period is usually for three days preceding the beginning of Lent, with special ceremonies on Shrove Tuesday. (See MARDI GRAS.) An outgrowth of the Roman Saturnalia, the celebration at first began on Jan. 7 and continued until Ash Wednesday. The period was gradually lessened through the activities of the popes, and only the wealthier classes began their merrymaking a week or 10 days before the poor people.

The principal European carnivals are held in Rome, Venice, Milan, Paris, Nice, Cologne and all through the south of France. They are famous for their races and water tournaments as well as for their grotesque and beautiful floats. It is often customary to wear costumes in the daytime or to the balls in the evening and to carry lighted tapers through the streets. Several American cities have carried the carnival idea and spirit into festivities of their own, though in most cases not actuated by religious considerations. The Mardi Gras of New Orleans was developed by French people according to French custom. In Pasadena, there is given on New Year's day a Tournament of the Roses, witnessed by more than 500,000 people. The Rose Festival of Portland, Ore., held annually in June, is another beautiful festival on the Pacific coast. The Ak-Sar-Ben, an organization of business men in Omaha, Neb., stage a yearly carnival concerned with the history and progress of the state. Every fall, there is given in St. Louis, the Veiled Prophet's Parade, followed by the crowning of a queen for the year.

**CARNIVORA**, the scientific name for an order of placental mammals, which includes the civets, mongooses, cats, wolves, bears, raccoons, skunks, otters, seals, and many other familiar animals. They are protected by furry coats, and usually provided with claws, never hoofs or nails. Most of them are terrestrial, but many are good climbers, and some are truly arboreal; others are semi-aquatic, while seals are real water animals, at a great disadvantage on land. Although as their name suggests they are mostly meat-eaters, some carnivores, as the kinkajous and many bears, are largely vegetarian.

**CARNIVOROUS PLANTS.** Many plants possess means by which small animals may be captured and in some cases used as food. Those which live on land capture insects almost exclusively and are treated under **INSECTIVOROUS PLANTS**. In the bladderworts, belonging to the genus *Utricularia* and its relatives and living mostly in water, protozoa, rotifers, small crustacea, insect larvae, and even newly hatched fish are trapped in small, usually lens-shaped bladders. Probably all species have bladders at some stage of their life, but they are often minute and in only a few species has their action been demonstrated. These have a rounded opening surrounded by a thickened collar against which a valve fits tightly and closes them effectually. Around the edge of the valve are several long bristles.

Before capturing its prey, the bladder is flattened and its lateral walls are in contact. Movement of the bristles by contact with a swimming animal acts as a lever, forcing the valve away from the collar. The elastic walls of the bladder then immediately expand and a quantity of water is drawn in, carrying with it the animal which has disturbed the bristles. This action is almost instantaneous. When the bladder is thus filled, the valve again fits tightly against the collar, preventing the escape of the prey. Some animals so caught die quickly and are soon disorganized; others may live several days. Numerous minute hairs lining the bladder have an absorptive function and it is clear that food absorbed from the dead animals is used by the plant. The secretion by the bladderwort of a proteolytic or tryptic enzyme for digestion has often been suggested but is not fully proven. A single plant of the American *Utricularia vulgaris* has been estimated to contain in its bladders no less than 150,000 crustacea at one time. Press reports of man-eating carnivorous plants have no foundation in fact. See also **BLADDERWORT**.

H. A. G.

**CARNOT, LAZARE HIPPOLYTE** (1801-88), statesman and journalist, was born at St. Omer on Apr. 6, 1801. He was editor of the radical journal *Le Producteur*. He entered the Chamber of Deputies in 1839, and was made a senator for life in 1875. He died on Mar. 16, 1888.

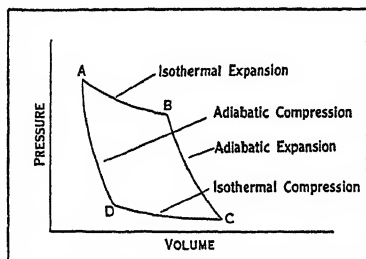
**CARNOT, LAZARE NICHOLAS MARGUERITE** (1753-1823), strategist and mathematician, was born at Nolay, Côte d'Or, on May 13, 1753. He entered the army in 1783, and became a captain in the engineering corps. In 1791 he was elected a deputy to the Legislative Assembly. Under the Convention he was appointed chief of the war department. Thus, to him fell the stupendous task of organizing in effective armies the vast bodies of raw recruits raised by the *levée en masse*. This he accomplished with a success that places him among the great constructive military leaders of modern times. He evolved a military system of offense which was largely responsible for the victories of Napoleon. In 1795 he was chosen a member of the Directory. In 1799, after Napoleon's *coup d'état*, he was made minister of war, but opposed the monarchist aspirations of the First Consul, and resigned. In 1814 he brilliantly defended Antwerp for Napoleon, and during the Hundred Days he was minister of the interior. Following the second Restoration he lived in Magdeburg, where he died on Aug. 3, 1823.

**CARNOT, MARIE FRANÇOIS SADI** (1837-94), statesman, son of Lazare Hippolyte Carnot, was born at Limoges on Aug. 11, 1837. After a technical education he became a government engineer. In 1871 he was elected to the National Assembly. In 1881 he became minister of finance, in which post he remained until 1886. In 1887 he was elected the fourth President of the Third Republic. He was assassinated by an Italian anarchist, Caeserio, at Lyons on June 24, 1894.

**CARNOT, NICHOLAS LEONARD SADI** (1796-1832), physicist, first son of Lazare Carnot, was born at Paris on June 1, 1796. He was educated at the École Polytechnique and entered the army, becoming an officer in the engineering corps. In 1824 he published *Réflexions sur la puissance motrice du feu*, in which he established the mechanical equivalent of heat and stated what is now known as "Carnot's principle." He died at Paris on Aug. 24, 1832.

**CARNOTITE**, an ORE of vanadium and uranium, occurring as a canary-yellow powder, or in small, platy crystals. It is mined in Colorado and Utah, where it occurs in sandstones with fossil wood and bones, and in veins with MALACHITE, AZURITE, pyrite and vanadium and chromium minerals. In composition, carnotite approaches a potassium-uranium vanadate. Uranium is valuable for its radium content, and vanadium in making special steels and copper alloys. Salts of each are used in chemical industries. See also VANADINITE; SAMARSKITE; PITCHBLEND; ORE DEPOSITS; VEIN; URANINITE.

**CARNOT'S REVERSIBLE CYCLE.** In 1824 the young French engineer, Sadi Carnot, published an investigation on the motive power of heat in which he analyzed the performance of a reversible engine. The working substance in this engine first absorbs heat isothermally (see ISOTHERMAL PROCESS). This process produces an isothermal expansion accompanied



PRESSURE-VOLUME DIAGRAM OF CARNOT'S CYCLE

by the performance of external work. The working substance is then allowed to expand adiabatically (see ADIABATIC CHANGE) and thereby does additional external work as its temperature becomes lower. At the lower temperature the working substance is compressed isothermally, and thereby some heat is given up to a refrigerator. If this isothermal compression is carried to the proper point, the working substance can now be brought back, by an adiabatic compression, to its original temperature, pressure and volume. Thus, the working substance has been carried through a cycle in which a certain amount of work has been done by it and a certain amount of heat has been transferred from a higher temperature to a lower. Theoretically, the process is reversible for, by doing an equal amount of work on the working substance, an equal amount of heat is transferred from the lower temperature to the higher. Technically, this is known as a *Carnot reversible cycle*. It is said to be bounded by two adiabatics and two isothermals. W. W. S.

**CARO, JOSÉ EUSEBIO** (1817-53), South American poet, was born in Ocaña, then part of the district of New Granada, Mar. 5, 1817. He studied philosophy and jurisprudence at the University of San Bartolome. From 1840 on Caro took an active part in political strife and fought in the campaigns of 1841 and 1842. He was a Deputy in the Congress of 1845; 4 years later he was compelled by a political upheaval to emigrate to the United States, whence he was unable to return until 1853. The poet died of yellow fever at Santa Marta, Jan. 29, 1853.

Caro, together with his friend, the poet José Joaquín Ortiz (1814-92), founded *La estrella nacional* in 1836. He also edited *El Granadino*, in which periodical he announced his desertion of the pen for the sword. Caro's political hostilities with Julio Arboleda are part of the national history of Colombia. His poetry is strongly lyrical, independent in its use of rhyme and meter and distinguished for its austerity.

**CARO, JOSEPH** (1488-1575), greatest rabbinic authority of the 16th century and the last great codifier of the laws of Judaism, was born in Spain in 1488. In 1492, the year of the expulsion of the Jews from Spain under King Ferdinand and Queen Isabella, Caro's father fled with him from his native land. For a time he lived in Portugal, Constantinople and Adrianople, and in 1523 became head of the academy in Nicopolis. He settled at Safed, Palestine, in 1536, then the center of the study of the Talmud and mysticism. Here he later became chief rabbi, and here in collaboration with Jacob Berab he wrote his famous *House of Joseph*, which was not merely a commentary on Jacob ben Asher's code, but also a compendium of the sources and Talmudic proofs for all the decisions contained in it, on the basis of and supplemented by other Halachic works and the decisions of later authorities of the post-Talmudic period.

Caro's main work, however, was the *Shulhan Aruch*. Intended for practical purposes, it offers ready information on all questions of Jewish laws. It was the first work of its kind in all Jewish literature, and was printed for the first time in Venice in 1565. It contains, besides countless ritual details and legal prescriptions, fine maxims regarding chastity, charity, brotherly love, commercial honesty and sanctity. The *Shulhan Aruch* soon became a very popular work, and is regarded as the almost infallible and authoritative guide for conduct by all orthodox Jews. The influence it exercised in strengthening the Judaism of the 16th and 17th centuries and in the formation of the Judaism of to-day can hardly be overestimated.

In his earlier years Caro had been an admirer of the romantic mystic SOLOMON MOLCHO, who initiated him into the mysteries and intricacies of the Cabala and inspired him with his own Messianic dreams. These early influences remained with Caro until the very time of his death. Indeed, like Molcho, Caro himself had dreams and visions, which he regarded as revelations coming to him from a higher power. When Molcho was burned at the stake in Mantua

in 1532, Caro, too, thought for a time of dying as a martyr at the stake as a holy sacrifice. He died at Safed, Palestine, in 1575. A. SH.

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**CAROB** (*Ceratonia Siliqua*), a medium-sized evergreen tree belonging to the senna tribe of the pea family, called also algaroba, locust tree and St. John's-bread. It is a native of dry soils in the eastern Mediterranean region, widely cultivated in mild climates since ancient times for its edible pods and also for ornament; it is planted in southern California and Florida. The tree, which sometimes grows 40 to 50 ft. high, bears numerous branches forming a rounded head; shining dark green leaves composed of 2 or 3 pairs of leaflets; flowers in small red clusters, and numerous flat pods, 6 to 12 in. long and 1 in. or more broad, containing many seeds surrounded by a sweet, fleshy, edible pulp. In various Mediterranean countries the large pods, rich in protein and sugar, constitute an important forage crop and are used to some extent for human food. Mature trees often yield 1,000 lbs. of pods annually. Carob pods are probably the husks mentioned in the parable of the Prodigal Son. The small seeds, remarkably uniform in mass, are said to have been the original carat weight used by jewelers and goldsmiths.

**CAROL II** (1893- ), King of Rumania, was born Oct. 16, 1893, the son of King Ferdinand and Queen Marie. He eloped with Zizi Lambrino, daughter of a Rumanian army officer in 1918, but later accepted the nullification of the marriage by the Rumanian supreme court. In 1921 he married Helen of Greece. Four years later Carol established residence in Paris with Magda Lupescu as his companion, and renounced his rights to the throne. On Ferdinand's death in 1927, Michael, infant son of Carol and Helen, became king, but three years later Carol returned to Rumania and on June 8, 1930, was proclaimed king.

**CAROLINE, QUEEN** (1683-1737), wife of George II, King of Great Britain and Ireland, was born in Ansbach, Germany, on Mar. 1, 1683, the daughter of the Margrave of Brandenburg-Ansbach. She married George Augustus, Prince of Hanover, later Prince of Wales, in 1705. In Oct. 1727 her husband succeeded his father to the throne as George II. Queen Caroline, because of her tact and tolerance, exercised considerable influence over the king and British politics. She was a powerful supporter of Sir Robert Walpole as prime minister, and surrounded herself with a distinguished literary circle. Caroline was the mother of eight children. She died on Nov. 20, 1737.

**CAROLINE INCIDENT**, an international controversy, 1837-42, which threatened to disrupt relations between the United States and Great Britain. An American owned steamboat, the *Caroline*, which had been carrying men and supplies from Buffalo to the Canadian Rebels (*see* REBELLION OF 1837) at Navy Island, was on the night of Dec. 29, 1837 fired by a Canadian Loyalist force, loosed from its moor-

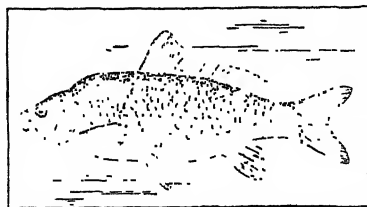
ings, and sent to drift over the falls. At least one American citizen was killed in the skirmish. In the subsequent excitement it appeared that the American border districts would spontaneously promote war against upper Canada. To maintain neutrality the New York militia was mobilized at the border, and Gen. Winfield Scott ordered to the scene by President Van Buren. In reply to American demands for redress the British Government replied that the particular violation of American territory was a necessary precaution in defense of the realm. In 1840 sentiment was again inflamed by the arrest of one Alexander McLeod, who in a New York saloon had boasted that he had killed an American in the attack upon the *Caroline*. The British Government demanded his release on the grounds that the Crown itself assumed responsibility for the attack; the Department of State alleged its powerlessness to interfere in a state trial. Danger was averted by proof at the trial that McLeod was lying. The original question of the invasion of American soil was arbitrated by Lord Ashburton and Daniel Webster in 1842. Ashburton expressed regret that the British Government had not apologized immediately after the occurrence.

**CAROLINE ISLANDS**, a large archipelago consisting of about 500 islands in the South Pacific Ocean. The largest of the Caroline group, which covers a total area of about 300 sq. mi., are Yap, Ponape, Kusaie and Truk. The surface is for the most part hilly, the highest point of land being a little more than 3000 ft. above the water. There is rich tropical vegetation. Copra is the chief product. These islands were bought by Germany from Spain in 1899. By the Treaty of Versailles following the World War they were mandated to Japan together with other German Pacific possessions. Pop. 1930, about 35,000.

**CAROLINGIAN DYNASTY**, a family usually grouped, though not with strict accuracy, as kings of France, for they were just as much kings of Germany, and called themselves kings of the Franks. The family was raised to importance by Pepin of Heristal (d. 714), mayor of the palace of Austrasia. His son, Charles Martel, drove the Moors out of most of Aquitaine and further reduced Neustria, but always under the fiction of maintaining the Merovingian kings. His son, Pepin the Short (d. 768), however, supplanted the last of these and with papal approval had himself declared King of the Franks. On this foundation his son Charlemagne raised his brief Empire. The territorial dominions of the Franks which at their greatest had extended from beyond the Elbe to the Ebro and south of Rome, broke into three sections, in each of which feudal power practically destroyed that of the king. With the extinction of the family of Lothair, the middle section split apart, and in the wreckage of the last days of the Carolingians appeared embryonic France and Germany. The last representative of the Carolingians in West Francia was supplanted by Hugh Capet in 987; the last in East Francia was Arnulf, who died in 899.

**CAROLUS-DURAN** (CHARLES AUGUSTE EMILE DURAND) (1838-1917), French painter, was born at Lille, July 4, 1838. He studied in Italy and in Spain, where he fell under the influence of Velasquez. *The Lady with the Glove*, exhibited 1869, turned the tide against the arid academism of the day and Duran became the most fashionable portrait painter of Europe. In subtlety he never approached Velasquez; in technique he was surpassed by his pupil, John Singer Sargent, but as a teacher his free, flexible method of painting had a beneficent effect on younger artists. Carolus-Duran died in Paris, Feb. 17, 1917.

**CARP**, a valuable food fish (*Cyprinus carpio*) native to fresh waters in eastern Asia and widely naturalized in other temperate regions. It has a stout compressed body, blackish-green above and yellowish



CARP

below, with four barbels about the mouth and a very long back fin. The carp grows usually from 1 to 3 ft. long and often reaches a weight of 10 to 20 lbs.

In China the carp has been domesticated in ponds for at least 2,000 years. Carp culture reached eastern Europe before the year 600 and in the 13th century had become established in Germany where it is still of great importance. Brought from Europe to the United States in 1877, the carp has become one of the most widely distributed fishes of the country.

The carp is dull and sluggish in habit, living in quiet weedy streams or ponds with muddy bottoms. It feeds chiefly on aquatic plants, insects, and other small animals, and when grown as a domestic animal in artificial ponds, it will thrive on the foods usually given to pigs or poultry. The fecundity of the carp is remarkable; a single female sometimes produces two million eggs. In America the carp does not rank high as a food fish, but it is important because of its abundance. The annual catch of carp in the United States usually exceeds 20,000,000 lbs., valued at upwards of \$1,000,000, produced mostly in the central states and marketed largely under other names.

**CARPACCIO, VITTORE** (c. 1465-1522), Italian painter, was born in Venice about 1465. He was a follower of Gentile Bellini. In 1490 he finished, in the school of St. Ursula, Venice, nine pictures taken from the life of that saint, which are now in the Academy of Venice. His chief work, *The Presentation in the Temple*, was painted early in the 16th century, and it was followed in 1511-15 by a series of paintings of St. Stephen for the school of San Stefano. His *Death of the Virgin*, at Ferrara, and *Dead Christ*, in Berlin, are other celebrated works. Carpaccio died in Venice about 1522.

**CARPATHIAN MOUNTAINS**, a great mountain range of south central Europe, describing a great curve, 800 mi. long, from Bratislava in Czechoslovakia to Orsova in Rumania, both of which are on the Danube River; their central portion touches Poland, the whole encompassing an area of 22,500 sq. mi. The fertile Hungarian plain lies within the arc. In the northernmost mountains is the loftiest peak, Gerlachovra, 8,737 ft.; but high summits are rare. In the north the heavily wooded slopes, which comprise some of the wildest and most desolate country of all Europe, support a pastoral population, largely Slav and Magyar. These people retain the costumes and customs of earlier days. In the southern mountains of Rumania a genial climate and numerous mountain passes, bringing contact with the outside world, have led to the development of more modern agricultural communities. The most rugged regions are sparsely peopled, and wolves, lynxes and bears prowl in the dense forests of fir and oak. There are numerous small lakes, and the headstreams of important rivers, including the Dneister and the Theiss or Tisa rise in the range. The mountains have abundant mineral resources and for centuries gold, lead, silver, copper and salt mines have been worked.

**CARPENTER, JOHN ALDEN** (1876- ), American music composer, was born at Park Ridge, Ill., Feb. 28, 1876. After studies at Harvard he entered business, but continued music instruction with Edward Elgar. In 1904 he published *When Little Boys Sing*, and in 1907 appeared *Improving Songs for Anxious Children*. His orchestral suite, *Adventures in a Perambulator*, was well received in 1914. *The Birthday of the Infanta* was produced by the Chicago Opera Company in 1919, and in 1926 the New York Metropolitan Opera presented his *Skyscraper Ballet*, repeated at Munich in 1928.

**CARPENTER BEE**, a solitary bee of either of two hymenopterous families: *Ceratinidae*, if of small size, or *Xylocopidae*, if of large size. *Ceratina dupla*, a familiar species of the first family, is a bluish-green bee, about 1/4 in. long. The female lays her eggs in pithy plants, making separate cells with plugs of plant fiber. The species *Xylocopa virginica*, found in the northern United States, is large and noisy. It bores tunnels in solid wood, making a short perpendicular entrance into the longitudinal burrow, which may be 18 in. long. Its eggs, also, are laid in separate cells, the partitions made of sawdust cemented with salivary secretion. Several bees may use the same entrance, their burrows going off in different directions. See also BEE.

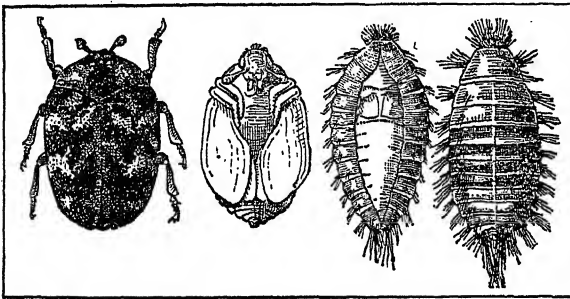
**CARPENTER GOTHIC**, in architecture, a name applied to the local developments of the Gothic Revival in which wood was extensively employed. The jig-saw was much used to produce flat, pierced tracery forms for barge boards and cornices. Vertical boarding with the joints covered by molded battens was often used for walls, both outside and in. All sorts of naïve modifications of Gothic details, such as pinnacles, buttresses and pointed arches, are common.

The results vary from absurdities, where the attempt to copy stone forms is dominant, to occasional build-ings of true naïve charm, where the Gothic detail has been most modified, as in a Gothic church at Bath, Me. For bibliography see MODERN ARCHITECTURE.

**CARPET.** See RUGS AND CARPETS.

**CARPET-BAGGERS**, political adventurers from the northern states who, during the RECONSTRUCTION ERA, gained control of the State governments in the South by exploiting the Negro vote; also, those who went South to make money by devious arrangements with the corrupt governments of that era. Rabid Southerners applied the term indiscriminately to all men from the northern states who held office in the South. The term was originally used to characterize private bankers in frontier towns, some of whom, in fact, began business with no more personal property than the contents of a carpet bag.

**CARPET-BEETLE**, several species of very small beetles of the family *Dermestidae*. Their larvæ are household pests often known as buffalo-moths. The commonest species is *Anthrenus scrophulariæ*. Adult



CARPET-BEETLE

Adult, pupa, larva (ventral and dorsal surfaces), enlarged

beetles are black, with wing-covers mottled with white spots, and have a brick-red band on the back where the wings meet. The larvæ are short, fat grubs, thickly covered with dark hairs. They feed upon carpets, woollens, feathers and furs. Rugs are less subject to attack than carpets, as they can more easily be taken up and cleaned. Adult beetles feed on the pollen of flowers. Frequent and thorough housecleaning is the chief control measure. Store all clothing, especially woollens, in tight boxes with paradichlorobenzene.

**CARPET GRASS** (*Axonopus compressus*), a valuable forage plant, common in the tropics and found widely in the southern United States. It is a prolific perennial, spreading rapidly by stolons, with broad leaf blades and slender flowering spikes. In alluvial or mucky lowlands along the coast from Virginia to Florida and Texas it is the chief pasture grass.

**CARPET SWEEPER**, a machine to pick up dust and lint from a carpet. It consists of a dust-box mounted on wheels which drive two revolving brushes. The dust, loosened by the action of the brushes, is swept by them into shallow pans at each end of the box. The pans can be quickly emptied by a tilting mechanism actuated by a trigger.

**CARR, BENJAMIN** (1769-1831), English musician, was born in England in 1769. After winning success as a singer on the English stage, he came to the United States in 1793, and gained a reputation at Philadelphia, Pa., as a singer, pianist, organist, and conductor. He organized the Musical Fund Society in 1820. His published works include *Masses, Vespers, and Litanies, A Collection of Chants*, and *The Archers*, the latter an opera, first produced at New York, Apr. 18, 1796. He composed the *Federal Overture*. He died at Philadelphia, May 24, 1831.

**CARRACCI**, a family of 16th century Italian painters who founded in Bologna a school known as the Eclectics. Their aim was to assimilate the best characteristics of the painters of the Renaissance. Their ideals surpassed their performance, however, and they are now classed as Decadents.

Lodovico Carracci (1555-1619), who was born at Bologna, Apr. 21, 1555, was the originator of the school, which he established in 1589, after studying in Venice under Tintoretto. As a painter he was surpassed by his younger associates. In the Academy of Bologna is his *Madonna with Four Saints*. He died at Bologna, Nov. 13, 1619.

Agostino Carracci (1557-1602), nephew of Lodovico, was born at Bologna, Aug. 15, 1557. He was more successful as an engraver than a painter, but he had a share in the frescoes of the Farnese Palace in Rome and Domenichino found inspiration for his own masterpiece in Agostino's *Communion of St. Jerome*, in the Academy of Bologna. Agostino died at Parma, Mar. 22, 1602.

Annibale Carracci (1560-1609), brother of the preceding, was also born at Bologna. He was the greatest artist of the family and his works abound in European galleries. The Farnese frescoes are counted his masterpiece. In the Louvre is his *Madonna of Silence* and a *Resurrection*, as well as several other canvasses. Annibale died in Naples, July 15, 1609.

**CARRAGEEN**, a name given to the IRISH Moss, a branching seaweed common on north Atlantic shores utilized to a limited extent for food.

**CARRANZA, VENUSTIANO** (1859-1920), Mexican President, was born in Cuatro Ciénegas, Coahuila, in 1859. He was governor of the State of Coahuila and became the leader of the Constitutionalist forces opposed to the government of VICTORIANO HUERTA. In 1917 he was elected president of Mexico. He antagonized the United States, Great Britain and France by decreeing nationalization of petroleum lands and after three years of power fled before a revolt led by Gen. ALVARO OBREGÓN. He was captured and killed at Tlaxcalaltongo, Puebla, May 21, 1920.

**CARRARA**, a town in the northwestern part of the peninsula of Italy, situated 3 mi. east of its port, Avenza. Carrara has an Academy of Fine Arts, containing antiquities and modern sculptures, and a 13th-century cathedral. It has been noted since Roman times for its quarries, which still yield fine white and colored marbles. In 1926 the town exported 600,000 tons of marble. Pop. 1931, 58,511.



**CARREL, ALEXIS** (1873- ), biochemist and surgeon, was born at Sainte Foy les Lyon, France, June 28, 1873. Receiving his degree in medicine from the University of Lyons, in 1900, he became a member of the faculty of medicine there until 1905 when he came to the United States. After a year with the University of Chicago, he joined the staff of the Rockefeller Institute at New York in 1906. He made a number of improvements in the technique of surgery, particularly in cases of blood transfusion, but his most famous accomplishment was the cultivation of living tissue in salt solutions, completely cut off from the body of which it had been a part. He succeeded not only in keeping such tissue alive, apparently indefinitely, but succeeded in having it grow. His discoveries enabled him to make surgical transplantation of blood vessels and organs. In 1912 he received the Nobel Prize in Medicine. During the World War he was associated with Dakin in the development of more perfect antiseptic treatment of wounds by use of chlorinated soda solution.

**CARREL-DAKIN SOLUTION.** See CHLORINATED SODA, SURGICAL SOLUTION OF.

**CARREÑO, MARIA TERESA** (1853-1917), celebrated woman pianist, was born at Caracas, Venezuela, Dec. 22, 1853. She made her New York debut at the age of 9, later studying with ANTON RUBINSTEIN, L. Gottschalk, and G. A. Mathias. In subsequent tours on both sides of the Atlantic her vigorous style earned her the name of "the Valkyr of the piano." She composed the national anthem of Venezuela, and also wrote a string quartet and works for the piano. In 1875 she made her debut in opera, appearing in *Don Giovanni* at New York, but returned to the pianoforte soon afterward, resuming her recitals in 1889. She died June 13, 1917.

**CARRERA, JOSÉ MIGUEL** (1785-1821), Chilean dictator, was born in Santiago, Chile, Oct. 15, 1785. During the revolution in 1810 he maneuvered to attain the post of chief executive and then proceeded to dissolve Congress and assume dictatorship. In 1813 he was deposed by the Chileans and after the Battle of Rancagua fled to Argentina, whence he traveled to the United States to secure ships and arms. He tried to return in 1816 but was prevented by the Argentines and was executed at Mendoza, Sept. 5, 1821.

**CARRERA, RAFAEL** (1814-1865), Central American soldier and president of Guatemala. He came to prominence in the revolution against President Morazan of the Central American Confederation in 1837. After Morazan was overthrown and the Confederation dissolved, Carrera became president of Guatemala, in 1847. He was twice elected, and in 1854 became perpetual president, serving until his death. Carrera was illiterate but intended to rule well. The conservatives who had supported him soon found that he could not be used as a tool, but he did not know how to accomplish his aims and his quarter century of rule advanced Guatemala but little.

**CARRÈRE, JOHN MERVEN** (1858-1911), American architect, was born November 9, 1858, at

Rio de Janeiro. He studied drawing in Europe. In 1887 he formed the firm of Carrère & Hastings, New York. His early works include hotels and office buildings in various parts of the country, and his success was due in part to his use of Renaissance and classic motifs in modern construction. In 1901, his firm made drawings for the gardens and decorations of the Pan-American Exposition at Buffalo, N.Y. His finest works are the New York Public Library, the Senate and House office buildings, Washington, D.C., and the Century Theater, New York City. He died at New York City, March 1, 1911.

**CAR RETARDER.** A device used in classification yards (see RAILROAD YARDS) to reduce the speed of freight cars. Steel plates, pressing against the sides of the wheels, effect the required braking action.

**CARRIAGE TAX CASE** (Hylton vs. United States), a case involving the question whether a tax on carriages levied by Congress was a direct tax within the meaning of the Constitution. This was the first instance in which the Supreme Court passed on the constitutionality of an act of Congress. The facts were fictitious; counsel on both sides were paid by the Government. Hylton was alleged to have refused to pay tax and penalty upon 125 "chariots" which he kept for his private use. This figure was necessary to give the Federal Circuit Court jurisdiction in the sum of \$2,000. Alexander Campbell and Jared Ingersoll pleaded for Hylton, and were opposed by Att. Gen. Charles Lee and Alexander Hamilton (his first appearance before the Supreme Court). The decision, rendered Mar. 8, 1796, upheld the statute. See also MARBURY vs. MADISON.

**CARRICKFERGUS**, a port and watering-place of County Antrim, Northern Ireland, about 10 mi. from Belfast. Colonized in the 12th century, by the 13th century its castle, situated upon a high rock with the sea on three sides, was embroiled in border wars and was frequently attacked by Irish chieftains. Carrickfergus became a Protestant refuge during the Civil Wars. The modern town cannot compete commercially with nearby Belfast, but it has some trade in linen, leather, oysters and spirits. Pop. 1926, 4,749.

**CARRIER**, a group of American Indians, speaking dialects of the Northern division of the Athapaskan linguistic stock, inhabiting the upper branches of the Fraser River and the district as far south as Alexandria, Brit. Col. They are known also as Takulli. The Carrier have many customs in common with the Indians of the north Pacific Coast, particularly the Tsimshian and Heiltsuk. They live in permanent villages which they leave seasonally for hunting and fishing expeditions. Socially they are organized into two classes: hereditary noblemen and commoners, the latter hunting for the former. The clan organization is exogamous, each clan claiming individual hunting-grounds.

**CARRIER**, a means of transportation, either private or common, of persons or of freight. The distinguishing feature of a COMMON CARRIER is that he undertakes generally, and for all persons indifferently, some

described form of transportation. The offering may be by written or verbal announcement, or it may be implied from a course of conduct, as when a taxi-driver takes his stand on a public square. Regularity of service and established rates of charge are sometimes spoken of as characteristics of a common carrier, but these practices may be better regarded as evidence of public offering than treated as independent tests of common carriage. In contrast to common carriers, private carriers transport for particular customers under special contract. Most auto bus lines are common carriers, while most trucking services are performed by private contract. The difference is important, because the obligations imposed upon common carriers by common and statute law are extremely severe. In general, such agencies are held to indiscriminate service, at reasonable and non-discriminatory rates. Passenger carriers are responsible for their negligence, but freight carriers are required in addition to deliver safely, not merely to use reasonable care, as is the case with private carriers. Such an obligation may, it is true, be qualified somewhat by contract, as by the provisions of a BILL OF LADING; but this is possible only within somewhat narrow limits.

The principal carriers in the United States are those engaged in railroad, inland waterway, automobile, street railway, pipe line, and air transportation. There is little basis for any distribution of passenger traffic among the various instruments of transportation, but motor vehicles and electric railways are certainly the principal carriers of passengers, with steam railways a poor third and inland waterways and airplanes in a relatively unimportant position. It may be added that motor vehicles have greatly improved their relative position, and that still further changes are to be expected. *See also* COMMON CARRIER. S. D.

**BIBLIOGRAPHY.**—D. C. Moore, *A Treatise on the Law of Carriers*. Statistical information on railroads, air, motor vehicle and inland waterway transportation can be obtained respectively from Interstate Commerce Commission, Bureau of Railway Economics, National Automobile Chamber of Commerce and U.S. Dept. of Engineers.

**CARRIER FREQUENCY**, in radio, the FREQUENCY of alternating current supplied to an ANTENNA, and, hence, the frequency with which wireless waves (*see* HERTZIAN WAVES) are radiated from an antenna when the antenna current is unmodulated. *See also* RADIO TRANSMITTER.

**CARRIER PIGEON**, a name sometimes applied to the homing pigeon but more properly to a fancy breed larger than the domestic pigeon with a circlet of bare skin surrounding the eyes and a large fleshy appendage on the bill. *See* HOMING PIGEON; PIGEON.

**CARRIERS OF DISEASE**, persons or animals or insects which harbor infective bacteria, generally without harm to themselves, and transmit them to others. The human being suffers from many diseases which are transmitted to him from animals, directly from insects, and from various other living species which carry the organism responsible for setting up disturbances. The human being also becomes infected from contact with germs that are transmitted to him

from other human beings who have previously been infected. The germs of typhoid fever, for example, may be conveyed to human beings through contamination of water or milk by the excretions of the person who has suffered with the disease, by contamination from the fingers of food handlers who have previously suffered with the disease and who carry the disease organisms in their excretions, or by direct contact with a person who is sick with the disease at the time. The most dangerous carriers of typhoid are persons who are entirely well, but who continue to harbor bacteria indefinitely and to transmit them in their capacity of cook or handler of food. Such persons as the noted Typhoid Mary, are generally registered by the police, and kept out of their menacing employment.

All men are more or less carriers of disease because they constantly distribute about them organisms with which they have been previously infected. The organisms may come from the secretions of the nose, throat and mouth; through coughing, sneezing, spitting and kissing; through contamination with secretions from the eyes, such as may come when one uses a handkerchief or towel that has previously been used by an infected person; through contamination from the excretions of the intestines and of the urinary tract, and even from contact with organisms that are on the human skin. These organisms are transferred from one person to another by direct contact, by contamination from sewage, food, water, air, dust and dirt, and by contamination from towels and similar utensils. Finally, a human being may be bitten by an insect which takes his blood and later inoculates it into another human being. So far as the spread of disease is concerned, the human carrier constitutes a constant menace.

Moreover, mass activities of mankind, such as attendance in large numbers at motion pictures, baseball and football games, crowded elevators, apartments and office buildings, tend to increase contact with diseased persons.

Among the diseases spread by secretions from the nose and throat are streptococcal infections, pneumonia, septic sore throat, meningitis, diphtheria, infantile paralysis, scarlet fever, measles, whooping cough, mumps, the common cold, influenza, tuberculosis and Vincent's angina. Among the diseases of the eye transmitted are pink eye, trachoma, gonorrheal ophthalmia. The intestinal disorders include typhoid, dysentery, cholera, amebic infection, hookworm, pinworm, and schistosomiasis.

Many of the organisms maintain special locations in the body; for example, the typhoid organism in the gall-bladder, and the various worms in the intestinal tract.

The venereal diseases are spread by contact with carriers who have been previously infected.

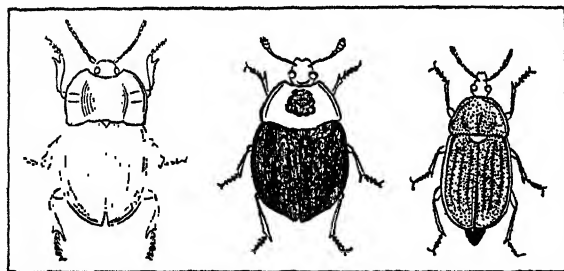
Organisms that live in the blood and that are carried from one person to another by insects are the plasmodium of malaria, carried by the anopheles mosquito. Other diseases carried by mosquitoes are

dengue, yellow fever, filariasis. The trypanosome of sleeping sickness is carried by the tsetse fly. Typhus fever and trench fever are transmitted by the louse. Bubonic plague is carried by the flea. Rocky Mountain spotted fever is carried by a tick. The demonstration of the fact that disease can be carried by a tick was first made by Theobald Smith in Texas in the case of tick fever. Later it was shown that other diseases are transmitted by ticks. Other insects suspected of carrying disease, but not absolutely incriminated, include bedbugs, water bugs, cockroaches and ants.

Among animal carriers of disease are the dog and various wild animals of the dog type which transmit hydrophobia; the cat, which has been incriminated with the transmission of diphtheria; the cow, which, by way of its meat, may transmit various worms, and, by way of its milk, tuberculosis, septic sore throat and undulant fever; the sheep which is incriminated with the transmission of anthrax; the goat with Malta fever; various fish in connection with tapeworms; the oyster with typhoid; the hog with trichina and various worms; the rat with plague and rat-bite fever; the rabbit with tularemia, and the parrot family with psittacosis.

See also CHILDREN, DISEASES OF: Infectious Diseases; QUARANTINE; TROPICAL MEDICINE. M. F.

**CARRION-BEETLE**, any beetle of the family *Silphidae*. The best-known species represent two genera, *Silpha* and *Necrophorus*. Members of the genus *Silpha* are mostly small, flattened creatures which creep beneath dead animals. The burying-beetles (genus *Necrophorus*) are much larger insects.



CARRION-BEETLES

*Necrophilus  
subterraneus**Silpha  
americana**Silpha  
atrata*

They dig beneath the body of a dead bird or small animal, removing the earth, so that the body gradually settles into the excavation; it is then covered with earth. Finally the female digs down to it, laying her eggs upon it. These insects have been known to roll the body of a large rat several feet, to place it in a spot suitable for burial. The larvæ feed upon the buried carcass, hence are useful as scavengers. See SCARAB BEETLE.

**CARRION-FLOWER**, a genus (*Stapelia*) of low, fleshy, cactus-like herbs of the milkweed family, so named because of the usually fetid odor of their flowers. There are about 60 species inhabiting arid districts from tropical to southern Africa. Notwith-

standing their offensive smell, several species are grown in greenhouses for their beautiful variegated, exceedingly large flowers, sometimes a foot across. They are plants of grotesque appearance, with swollen, four-angled, usually leafless stems. As in the cactus, the outer-surface of the stem contains the green tissue, while the center is utilized for water-storage. In eastern North America an unarmed, herbaceous species of greenbrier (*Smilax herbacea*), with small, greenish, ill-scented blossoms, is called carrion-flower.

**CARROLL, CHARLES** (1737-1832), American statesman, was born at Annapolis, Md., Sept. 19, 1737. He was educated in France, and returned to Maryland at 28 to develop a 10,000 acre tract known as Carrollton Manor, from which he took the name Carroll of Carrollton. He was a delegate to the Continental Congress in July 1776, signed the Declaration of Independence, and staunchly supported the Revolution, although he risked confiscation of his estate. He represented Maryland in the first Federal Congress, 1789-92. He retired to his estate in 1800. He was the sole surviving signer of the Declaration of Independence when he died at Baltimore, Nov. 14, 1832.

**CARROLL, JOHN** (1735-1815), first American Catholic prelate, was born at Upper Marlborough, Md., Jan. 8, 1735. He received his religious education at St. Omer's College in French Flanders and at the Jesuit College at Liège, where he was ordained. He held professorships at Liège and at St. Omer's, and in 1774 returned to America, working at a mission at Rock Creek, Md. In 1776 he joined with Benjamin Franklin and others who were sent by the Continental Congress on a mission that attempted to secure the neutrality of the Canadians in the impending conflict with England. Carroll was the author of the first Catholic work written by an American Catholic published in the United States. He was responsible for the establishment, in 1791, of Georgetown College, now Georgetown University. In 1789 he was made the first American Catholic bishop, and was raised to the Archbishopric in 1808. He died at Washington, D.C., Dec. 3, 1815.

**CARROLL, LEWIS.** See DODGSON, CHARLES LUTWIDGE.

**CARROLLTON**, a commercial and industrial city in western Georgia and the county seat of Carroll Co. It is situated on the Little Tallapoosa River, 52 mi. southwest of Atlanta and is served by the Central of Georgia Railroad. The leading products of the region are cotton, fruit, poultry and live stock, and Carrollton has considerable trade in these commodities. The manufactures include cotton products, cotton-seed oil, flour, fertilizer, bricks, lumber and steel, iron and machine-shop products. Marble is quarried in the vicinity. Pop. 1920, 4,363; 1930, 5,052.

**CARROT**, an Asiatic and European biennial plant (*Daucus Carota*) of the parsley family, the supposed original species of which, called Queen Anne's lace, is a troublesome weed on neglected land. Horticultural improvement seems to have begun in Holland

whence the carrot was introduced into English gardens during the reign of Queen Elizabeth. It is generally grown, though less extensively than many other vegetables, mainly because its chief uses are for flavoring soups and stews. Its merits have made it increasingly popular, however, as an individual vegetable.

#### CARROTS, COMMERCIAL PRODUCTION, U.S.

4-Year Average, 1927-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES . . . . .	29,023	9,309,000	100.0
LEADING STATES:			
California . . . . .	6,730	3,418,000	36.7
Louisiana . . . . .	7,407	1,388,000	15.4
New York . . . . .	2,275	1,157,000	12.8
Texas . . . . .	6,448	1,393,000	15.4
New Jersey . . . . .	1,750	446,000	4.9

Carrots are so hardy their seed may be sown in earliest spring and the roots left in the ground until late fall without danger of damage. A rich friable loam is most suitable to this crop. As the seed is slow to germinate, "forcing" radish seeds, about one to the inch, should be sown with it to mark the rows so that tillage may start promptly. If the radishes are removed within four weeks the carrots will not suffer. When the carrot plants are 3 or 4 in. tall they must be thinned to 2 to 4 in. asunder. Early varieties require about ten weeks to reach edible size; late ones from early spring until late fall. M. G. K.

**CARRUTH, WILLIAM HERBERT** (1859-1924), American poet, was born at Osawatomie, Kan., Apr. 5, 1859, and educated at the University of Kansas and at Harvard. He was professor of German at the University of Kansas, and then professor of Comparative Literature and head of the English department at Leland Stanford University. Carruth translated several works of Schiller, and wrote *Each in His Own Tongue*, a collection of verse, and *Verse Writing*, a handbook for students. He died Dec. 15, 1924.

**CARRYING CHARGES**, charges made by the **BROKER** for carrying for his customer **STOCKS** purchased on **MARGIN**. Interest on the money advanced by the broker to finance the transaction is the major item of cost. The broker, under the law, is entitled to charge his customer the legal rate of interest or, if money conditions are stringent, usually as much as he himself must pay for funds.

The term is also applied to the costs of carrying a speculative or other transaction in real estate. Here, interest on the covering **MORTGAGE**, taxes (*see TAXATION*), **INSURANCE**, **DEPRECIATION**, and even repairs and maintenance, are classed as carrying charges. In **CREDIT** and **BANKING**, the term is sometimes applied to the cost of carrying customers' or depositors' accounts. In merchandising the carrying charges on inventories include actual or hypothetical interest on **CAPITAL** invested in such stocks, depreciation due to shelf wear, style changes, insurance, and similar costs.

**CARSON, CHRISTOPHER (KIT)** (1809-68), American frontiersman, was born in Madison

Co., Ky., Dec. 24, 1809. His adventurous life began with trapping and hunting in the wilds of New Mexico and California, after which he took part in Frémont's explorations beginning in 1842, and became a popular hero through his spectacular bravery. In 1853 he was appointed Indian Agent at Taos, N.M., and during the Civil War he campaigned against the Apaches and Navajos, took part in the battle of Valverde, and was brevetted brigadier general. He died at Fort Lyon, Colo., May 23, 1868.

**CARSON CITY**, the capital of the state, a city in western Nevada, the county seat of Ormsby Co. It is situated near the foot of the Sierra Nevadas, 12 mi. east of Lake Tahoe, at an altitude of 4,720 ft. above sea level. The city has a branch of the United States Mint, now used as a government assay office, a government school for Indians, the state penitentiary and state orphans' home. The museum has a unique collection of mastodon skeletons and fossils found in the vicinity. Gold, silver and copper are mined near-by. Carson City, named in honor of "Kit" Carson, was plotted in 1858, became the capital in 1861 and was made a city in 1875. Pop. 1920, 1,685; 1930, 1,596.

**CARTAGENA**, a city and Caribbean port of Colombia and capital of the state of Bolivar. It is an important industrial and commercial center of Colombia; it is connected with the Magdalena River by the Cartagena Railway, and much of the interior commerce of Colombia is conducted over this route. The climate is hot. The city lies on an island, separated from the mainland by a natural canal over which a causeway is built. A fortified wall, 40 ft. thick in places, surrounds the old city, which has thick-walled stone and brick buildings and narrow streets. The city exports hides, rubber, medicinal plants from the neighboring forests, and crude oil. It was founded in 1533, and was captured by **SIR FRANCIS DRAKE** in 1586. Pop. 1928, 92,494.

**CARTAGENA**, a city of southeastern Spain in the province of Murcia, on the Mediterranean. A naval base and fortress of first rank, it has one of the best Mediterranean harbors. It has a 13th century cathedral and a city hall with a Moorish portico. The city produces sailcloth, rope, paper, glass, china-ware and esparto products. The imports are chiefly coal, lumber, machines, codfish and dry goods; the exports, silver, zinc, iron and manganese ore, esparto grass and fruit. Cartagena is the seat of a bishop and has a military governor and a naval commander. It was founded by the Carthaginian general Hasdrubal in the 3rd century B.C. Est. pop. 1929, 101,000.

**CARTAGO**, a city of Costa Rica, situated about 12 mi. east of San José, and 92 mi. from Port Limon. It has an altitude of 4,930 ft. and a mean temperature of 78°. The volcano of Irazu rises just above the town, and there are hot mineral springs at Agua Caliente, a suburb. In spite of frequent earthquakes many of the old churches and other buildings still stand. Founded in 1522, until 1823 it was the capital of Costa Rica. Coffee and cattle are the chief

products of the surrounding districts. Est. pop. 1930, 7,398.

**CARTEL**, a combination of industrial or business enterprises, engaged in the same industry, for the purpose of establishing a monopolistic control of the market. Cartels are European in origin and first attracted wide attention in the United States in 1926-7, when they were considered a symbol of Europe's resentment against the American foothold in European markets and a weapon for fighting America's mammoth industrial enterprises. The International Steel Cartel sought to associate all the principal steel producers except those of the United States. The Franco-German potash agreement was said to be an attempt to capture the American market. The aluminum cartel appeared to be an attempt to gain control of that one-half of production not already in the hands of Americans. At the request of certain American industrialists, the International Economic Conference at Geneva published a series of documents on the question and the U.S. Department of Commerce made a survey of cartels in 1930. This survey revealed that international trade agreements to sustain prices in 1930 in the face of world-wide overproduction, were generally unsuccessful. Government experts examined European cartels in steel, rayon, cement, aluminum and coal and intercontinental agreements on nitrates, sugar and copper, and found that in no case was the objective of the cartel attained. Liefman, European authority on cartels, asserts that by the outbreak of the World War there were already 114 international agreements of this character in existence. The first cartel was organized in Germany in 1862 by six firms who were at that time the only producers of tinned metal sheets in Germany. The earliest conspicuously successful cartel was organized in 1883 and was known as Irma, the International Rail Makers' Association and survives today as Erma, the European Rail Makers' Association. During the half-century preceding 1920, the cartel, known as a syndicate or convention, became a striking feature of the commercial and industrial life of Germany and at the close of this period there was scarcely a basic industry, the production, sale or distribution of whose products was not in some sense controlled by cartel. The rise of cartels is comparable with the rise of great industrial holding companies in the United States with which it is contemporaneous. Types of cartel agreements are those affecting prices, territorial control, production and patents. The purpose of the cartel is not to conduct a business undertaking in its own name or in joint account. It is a union of business enterprises that retain their identity except with regard to the subject matter of the mutual contract that binds them together. It closely resembles a federation of sovereign states. Every cartel aims to establish a monopolistic control over the market. The test of its success is its ability to influence the spread between the cost and the sales price of a commodity. The cartel came into existence in its present form as a result of the employment of large capital in indus-

try and mass production leading to overproduction and consequent price cutting.

**CARTER, MRS. LOUISE LESLIE** (1862- ), American actress, was born at Lexington, Ky., June 10, 1862. She made her first stage appearance in 1890 at the Broadway Theatre, New York City, as Kate Graydon in *The Ugly Duckling*. During 1890-1906 she was under the management of DAVID BELASCO and rose to stardom in emotional rôles in *The Heart of Maryland*, *Zaza*, *Du Barry* and *Adrea*, later playing in *La Tosca* and *The Second Mrs. Tanqueray*. Beginning in 1913 she toured in *Zaza*, *Camille*, *Magda* and *The Gay Lord Quex*.

**CARTERET, SIR GEORGE** (1610-80), English politician, was born on the island of Jersey between 1609 and 1617, grew up at sea and served in the British Navy until Charles I made him governor of his native island, which became a refuge for royalists. The commonwealth took it in 1651 and Carteret lived abroad until the Restoration when he became treasurer of the Navy. Later he was one of the proprietary owners of the Carolinas in America. New Jersey was so named in his honor as governor of Jersey. He died about Jan. 14, 1680.

**CARTERET**, a manufacturing borough of Middlesex Co., N.J., located on the Arthur Kill and on the Central Railroad of New Jersey, 10 mi. south of Newark. Its industries include the manufacturing of paints, iron, steel and chemical products, and the importation and milling of hard woods. In 1929 the manufactures reached a total of about \$15,000,000. The retail business in 1929 amounted to \$3,747,550. Carteret was founded in 1906 and incorporated in 1907 under the name of Roosevelt. Later the name was changed to Carteret in honor of the Carterets, original proprietors of the district under the British crown. Pop. 1920, 11,047; 1930, 13,339.

**CARTERSVILLE**, a city in northwestern Georgia and the county seat of Bartow Co. It is situated in an agricultural and mining region, 41 mi. northwest of Atlanta, and is served by three railroads: the Seaboard Air Line, the Louisville and Nashville, and the Nashville, Chattanooga and St. Louis. Gold, iron, graphite, manganese, ocher and barite are mined in the vicinity. The industries include knitting mills, cotton-seed oil mills and fertilizer and paint factories. Etowah Mound, one of the largest of the prehistoric Indian mounds, is 3 mi. southeast of Cartersville. Pop. 1920, 4,350; 1930, 5,250.

**CARTESIANISM**, a term used in several ways to emphasize prominent aspects of the philosophy of RENÉ DESCARTES (1596-1650), with whom modern philosophy is sometimes said to begin. It may refer either to his method of doubt, his analytical procedure or his solution of the mind-body problem.

Descartes has become famous as a doubter, for he doubted everything until he came to his own existence. This he could not doubt and it led to his well-known *Cogito ergo sum*. From this starting point he erected his system by means of a rationalistic procedure. He was above all else a mathematician and



this influenced the method by which he built up his philosophy. The term Cartesianism may refer either to his original method of doubt or the later method of developing his system.

The mind-body problem figures largely in Cartesian thought. Descartes was a dualist in that he recognized two fundamental substances, viz., mind and matter. As regards the relation of these substances in the human body, he located the soul in the pineal gland, this being the connecting link between the two. The mind could thus influence the body and the body influence the mind. This teaching was taken up by his followers, known as the Cartesian School, and led to OCCASIONALISM, which is a slight modification of the original Cartesian position.

**CARTHAGE**, an ancient city on the northern coast of Africa. Its site is situated a few miles from the modern Tunis.

Carthage was founded in the 9th century B.C. by the great Phoenician commercial city, Tyre, after several other colonies on the African coast. Situated on an easily defensible peninsula with good harborage, she early became the most powerful Punic colony in the west. The native tribes, who had consented to her foundation, were easily subdued; new settlements were sent out for trading purposes to Sicily, Corsica, Sardinia, the Balearic Islands, the Canaries, Madeira and Spain; and even the older cities of Libya were subjected to her and forced, with the natives, to contribute to her revenues. By the 6th century she was the leading commercial power of the west, with ships plying from Britain to Syria, and caravans penetrating to Ethiopia and Gaul. She made commercial treaties with Rome from 509 to 279 B.C., and was friendly with the Etruscans, but her relations with the Greek colonies were hostile. Greeks had settled Sicily and Marseilles, which Carthage considered practically her territory, by the 8th century, but Carthage waited until the Persians invaded Greece before striking the first blow, 480 B.C. Gelon, Tyrant of Syracuse, defeated the Carthaginians conclusively at Himera; it was the opening engagement of a terrible and protracted contest for Sicily, which occupied the entire 4th century and ended with no gain for Carthage. Meanwhile Rome had become the greatest power in Italy, and a more serious menace to her trade than the Greeks. The struggle which followed extended over a period of 118 years. The First Punic War, 264-241 B.C., fought in Sicily, ended with both combatants exhausted. Carthage had to surrender not only her Sicilian territory, but a large indemnity which made it difficult to pay the professional troops she had hired. They turned fiercely against her, and it was only after years of most relentless fighting (the "Truceless War," 241-238 B.C.) that she exterminated them. The Second Punic, or Hannibalic War, 218-201 B.C., was fought in Italy itself; the early victories of Hannibal were rendered insignificant by years during which his forces were disintegrated, and at the close Carthage lost Spain and was left crippled. Roman envy and commercial greed forced on her the

Third Punic War, 149-146 B.C., after which Carthage was utterly destroyed with all her inhabitants. The site was declared unholy, but under the leadership of C. Gracchus a Roman colony was planted there, 122 B.C., and was the center of a district which long provided Rome with grain.

**CARTHAGE**, a city in southwestern Missouri, the county seat of Jasper Co., situated on the Spring River, 150 mi. south of Kansas City. Bus lines and four railroads serve the city. There is an airport. Carthage is a shipping center for dairy and poultry products and small fruit. Its manufactures include dynamite, spring beds and work clothing and shoes. The natural resources of the region are marble, limestone, coal, zinc and lead. The city is the seat of a military museum and of Ozark Wesleyan College, which has an Ornithological Museum. Carthage was founded in 1842; incorporated in 1868. There was fighting here early in the Civil War. Pop. 1920, 10,068; 1930, 9,736.

**CARTHAMIN**, a red dyestuff obtained from the SAFFLOWER, a thistle-like plant cultivated in the Mediterranean region since ancient times.

**CARTHUSIANS** (Latin *cartusia*; English charterhouse, equivalent to French *chartreuse*, probably derived from Chartreuse, name of a village near which the first Carthusian monastery was established), monks of the Carthusian Order, founded by St. Bruno in 1084, in the Alps 14 mi. northeast of Grenoble, France. In the beginning, the life was patterned on that of the Egyptian hermits, but as numbers were attracted it was gradually combined with community life as in the Camaldolese Order, with statutes based on the Rule of St. Benedict and of Camaldoli. The Eastern arrangement of hermitages grouped around a monastery was adapted to preserve the requisite solitude. Although the monks amassed a valuable library at La Grande Chartreuse, poverty was strictly observed and the proceeds from the manufacture of the famous liqueur known as Chartreuse, by which the community supported itself after the French Revolution, went largely to charity. In 1906 the French Government suppressed these monks, and they settled in Tarragona. The Carthusians now have 15 monasteries, called *chartreuses*, in European countries, and a few convents of nuns, making a total of approximately 900 religious.

**CARTIER, SIR GEORGES ÉTIENNE** (1814-73), Canadian statesman, was born at St. Antoine, Lower Canada, Sept. 6, 1814. He was educated at St. Sulpice, Montreal, and in 1835 was admitted to the bar. He became attorney general for Lower Canada in 1856 and was premier in 1858-62, when he enacted many progressive measures, including a bill for codification of the civil laws. The outstanding leader of the French Canadians during the last fifteen years of his life he was largely responsible for their acceptance of Confederation. On the formation of Dominion government in 1867 he became minister of militia in the new cabinet, a post he occupied until he died in London, May 21, 1873.

**CARTIER, JACQUES** (1491-1557), French discoverer, was born at St. Malo, Brittany. Commissioned by Francis I, King of France, to find a route to Asia by way of the new world he spent almost 10 years on expeditions for this purpose. Cartier discovered and explored the Gulf of St. Lawrence and the St. Lawrence River, sailing up the river as far as the present site of Montreal. He died at St. Malo, about 1557.

**CARTILAGE**, a tough, translucent, supporting tissue of the body. Cartilage precedes the formation of most **BONE**, is present on the articular surfaces of bones, partially surrounds the air passages of the lungs, and forms the costal cartilages connecting the ribs with the breast-bone. Microscopically it is composed of a clear, almost structureless matrix in which a large number of cells occupying lacunar spaces are imbedded. There are no blood vessels in cartilage.

The matrix of the cartilage reinforcing the external ear is pervaded by elastic fibers which enable it to regain its form when distorted. In other situations, notably between the bodies of the vertebrae, the cartilage is filled with tough, inelastic fibers which add to its strength.

**CARTOMANCY**, fortune telling by cards, a popular form of **DIVINATION** which has been elaborated through the ages in gypsy and other folk-lore, by assigning values to face cards.

**CARTON, SYDNEY.** See SYDNEY CARTON.

**CARTOON**, a pictorial sketch or caricature of some person or condition, intended to influence public opinion. Cartoons are circulated by newspapers and periodicals, and are usually expressive of a current trend of thought. In its original sense, a cartoon was a design or drawing used as a model in making a mosaic, tapestry, fresco painting, or other work of art. The essentials of a present-day cartoon include an idea, simplicity of expression, and a minimum of explanatory text. Some quality such as kindness, irony, derision, or satire is expressed, and almost always humor.

With its adoption by the press as a newspaper feature, the cartoon at times has a powerful influence. It is a pictured editorial whose message is grasped at a glance. The use of syndication has enabled even the smallest country newspaper to present its daily cartoon. This same syndication, however, has caused the cartoon to lose much of its force. In the distribution to a widely differing range of papers and communities, it has been generally necessary to modify the tone and qualify the message that none be offended.

In the United States a popular form of the cartoon is the **COMIC STRIP**. This is a series of related pictures, bearing a number of figures whose action and conversation develop the artist's idea. This type of cartoon is intended as purely humorous.



THE FIRST AMERICAN NEWS-PAPER CARTOON, PUBLISHED MAY 9, 1754

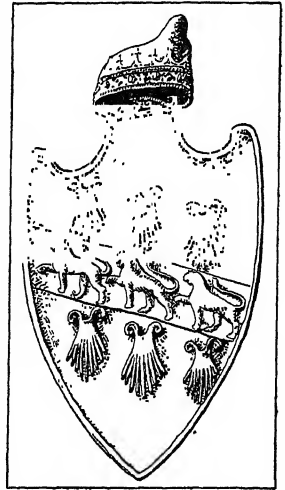
**CARTOUCHE**, an oval enclosed decorative panel containing an inscription or decoration, as the Royal cartouche of Egypt containing the hieroglyphs of the King's name; also a decorative shield, often embellished with leafage, scrolls and flying ribbons. The cartouche form began to be much used in the Italian Renaissance to carry heraldic coats-of-arms. At first simple, later examples became more and more complex with reduplicated scrolled frames. These richer types are characteristic of the baroque work of Italy and Austria, and similar forms are found in the later English Renaissance, and in the Henry IV and Louis XIII styles in France.

**CARTWRIGHT, EDMUND** (1743-1823), English inventor, was born at Nottinghamshire, Apr. 24, 1743. He was educated at Oxford and became rector of Goadby, Marwood,

Leicestershire and subsequently prebend of Lincoln Cathedral. By chance his interest was directed to machines replacing hand-work by mechanical work, and in 1785 he took out his first patent for a power loom for weaving. The new invention had to overcome fanatic opposition from both workers and manufacturers. Other inventions of Cartwright were machines for wool-combing and cord making, an alcohol steam engine, and various agricultural implements. He died at Hastings, Oct. 30, 1823.

**CARTWRIGHT, JOHN** (1740-1824), English parliamentary reformer, was born at Marnham, Nottinghamshire, on Sept. 28, 1740. He advocated the suppression of all parliaments, and composed many pamphlets to support his views. During the American Revolution he sympathized with the colonists and wrote in their defense. Universal suffrage had in Cartwright one of its most ardent adherents. In 1780 he was the founder of the noted "Society of Constitutional Information." **EDMUND CARTWRIGHT**, the inventor of the power-loom, was his younger brother. He died at London on Sept. 23, 1824.

**CARUS, PAUL** (1852-1919), German-American philosopher, was born at Ilsenberg, Germany, July 18, 1852. He studied at the universities of Greifswald, Strassburg and Tübingen. In 1883 he came to the United States, becoming editor in Chicago, Ill., of the *Open Court*, a journal devoted to the establishment of religion and ethics on a scientific basis. In 1890 Edward Hegeler, whose daughter Carus had married two years before, founded *The Monist*, of which Carus also assumed editorship. The Open Court Publishing Company of Chicago was founded under his direction, and among his many books published



RENAISSANCE CARTOUCHE FROM THE DUCAL PALACE AT VENICE

are: *Fundamental Problems*, 1889, *The Soul of Man*, 1891, and *The Gospel of Buddha*, 1894. Carus maintained that philosophy could be reduced to the objective view of the sciences, and he found a parallel between the principles governing nature and the "laws" of the mind. He died at Chicago, Feb. 11, 1919.

**CARUSO, ENRICO** (1873-1921), Italian tenor, was born at Naples, Feb. 25, 1873. His first singing experience was as a choir-boy in the churches of his native city. At 16 he became a receiving clerk in a Naples factory, and added to his income by singing at night at cafés and street festivals. In 1893, after some training under Guglielmo Vergine, Caruso determined to seek a career in opera, although his voice then gave little promise of its eventual power. He made his début at Naples in 1894, appearing in *L'Amico Francesco*. He spent the next three years as a member of itinerant opera troupes, meanwhile studying with Vincenzo Lombardi. In 1898 he made a sensational success at the première performance in Milan of *Fedora*, and in the next five years was enthusiastically received at Milan, Lisbon, Monte Carlo, and Rio de Janeiro. He made his American début at the Metropolitan Opera, New York, on Nov. 21, 1903, appearing in *Rigoletto*, and remained the leading tenor of the company for 17 years. His "golden" tenor, as it was popularly described, was one of the greatest male voices in the history of singing, and he possessed in addition a dramatic gift peculiarly suited to Italian opera. His celebrated rôles were in *Pagliacci*, *La Bohème*, *Aida*, *Carmen*, *L'Elisir d'Amore*, *Rigoletto*, and *Samson and Delilah*. He died at Naples, Aug. 2, 1921.

**CARVEL.** See BOAT DESIGNING AND BUILDING.

**CARVER, JOHN** (c. 1575-1621), American colonial governor, was born in England about 1575. He amassed a small fortune in trade in London before emigrating to Holland in 1609 where he joined the Pilgrims. He soon became a leader of the group and obtained financial support for the trip to America. He also obtained additional members of the party in England, among them Miles Standish and John Alden. He hired the Mayflower and soon after landing at Plymouth was chosen governor of the colony. He died at Plymouth Apr. 5, 1621.

**CARY, ALICE** (1820-71) and **PHOEBE** (1824-71), American poets, were born and brought up on a farm near Cincinnati, O., Alice, Apr. 26, 1820, Phoebe, Sept. 4, 1824. In 1850 a volume of poems by the two sisters won favorable attention. Alice wrote novels as well as poems; among her volumes of verse are *Lyra and Other Poems* and *Ballads, Lyrics and Hymns*. Phoebe is the author of the hymn beginning "One sweetly solemn thought." Alice died at New York, Feb. 12, 1871, and Phoebe a few months later, July 31, 1871.

**CARYATID**, a female figure used as a support. The male figure, so used, was called an Atlas (pl. Atlantes). Although not general, the use of the human form in this way was an occasional feature of Greek

building, and attained its most celebrated example in the Porch of the Maidens of the Erechtheum at Athens. Caryatids were also used by the Romans and during the Renaissance.

**CASABIANCA, LOUIS DE** (1755-98), French naval officer, was born in Corsica, in 1755. He was captain of the *Orient*, the flagship of the fleet which transported Napoleon and his army to Egypt. When Admiral Brueys was killed in the battle with the British off Abukir, Egypt, Aug. 1, 1798, Casabianca took command of his fleet. He was seriously wounded but refused to leave his ship when it took fire and died with his 10 year old son and his crew. Mrs. Hemans depicts their heroism in "Casabianca."

**CASABLANCA**, or Dar-el-Beida, Africa, the principal port of Morocco in the French protectorate. It lies on the western or Atlantic coast, 162 mi. southwest of Fez. Harbor developments, the most recent occurring in 1925, have done much to make it one of the leading ports of northern Africa. Casablanca is connected with Toulouse, Tangier and Rabat by air. The principal exports are cereals, wool, skins and eggs; the principal imports are sugar and cotton. The Portuguese founded Casablanca in 1468; the French took it by force in 1907 and in 1909 the controversy between Germany and France for possession was adjusted by the Court of International Justice. The year 1924 witnessed the completion of the electric power works. Pop. 1926, 106,608.

**CASA BLANCA CASE, THE**, resulted from the French seizure of the town of Casa Blanca on the Atlantic coast of Morocco, Aug. 5, 1907. Native disorders had followed French railway building, and over German protest the French landed troops to protect their interests. A settlement by arbitration satisfactory to neither side was reached in 1909. See ALGERIRAS CONFERENCE.

**CASA GRANDE**, the name given to the ruins of a prehistoric civilization in the Gila Valley in south central Arizona, 2½ mi. from Coolidge on the Southern Pacific Railroad. The land containing the ruins comprises 472.5 acres of desert and was established Aug. 3, 1918 as a National Monument. The ruins were first recorded in 1694 by Father Eusebio Francisco Kino, founder of Tumocacori mission. At that



CARYATID FROM THE PORCH  
OF THE ERECHTHEUM,  
ATHENS

time, the ruins had been deserted for well over two hundred years. Little is known of their history but apparently a nomadic people settled in the valley not less than 1,900 years ago. They established an irrigating system, the remains of which can still be seen, and then began the construction of buildings for dwelling and defense purposes. The Casa Grande or "Great House" from which the monument takes its name is the chief ruin. Commanding a view of the surrounding country for 10 mi., it seems to have been built for defense. It was originally four stories in height and is constructed with adobe walls 4 ft. thick. Probably between 8,000 and 15,000 people inhabited the region at one time. Cotton and corn were their chief agricultural products; they made excellent baskets and pottery, and used sea shells for ornaments and in their ceremonials. They can be generally classified as belonging to the Late Stone Age as no useful metal implements have been found.

**CASA GUIDI**, the home in Florence, Italy, of the poets ROBERT and ELIZABETH BARRETT BROWNING from 1848 till the latter's death in 1861, situated at 9 Piazza San Felice, on the south side of the Arno. In this house the Brownings' only child was born. *Casa Guidi Windows*, Elizabeth Barrett Browning's noted poem in *terza rima*, was written at Casa Guidi in 1851.

**CASALS, PABLO** (1876- ), Spanish violoncellist, born at Vendrell, Calalonia, Dec. 30, 1876, the son of an organist. At the age of 12 he could play a variety of musical instruments. He studied the violoncello at Madrid, and made his debut at Paris in 1895, at London in 1898, and in the United States in 1901. He founded the Barcelona Orchestra in 1919. He has written violoncello compositions, a *Miserere*, choral work, and two symphonic poems.

**CASANOVA DE SEINGALT, GIOVANNI JACOPO** (1725-98), Italian adventurer and memoir writer, was born in Venice in 1725. At the age of one year he was taken to London by his parents and left in the care of a grandmother, who gave him a sound education. When he was 16 years old he entered a seminary in Venice, but was expelled. Casanova now began his career of adventure, taking what positions happened to come his way and holding none of them long. In this manner he wandered over Europe, being regarded in Venice in 1775 with sufficient suspicion to warrant his arrest as a spy. He escaped from prison and made his way to Paris, where he obtained employment as a director of state lotteries and managed to obtain an entry into good society. His social gifts were such that, when he visited Prussia, Frederick II received him with favor; in Poland King Stanislaus Poniatowski also extended a kindly welcome to him. At Aix in 1764 he met CAGLIOSTRO. However, the authorities of Warsaw, Paris, Madrid and Venice found it expedient to expel him from their midst, those in Venice doing so even after they had employed him as a police spy from 1774 to 1782. In 1785 Count Waldstein appointed him librarian in his chateau at Dux, Bohemia; it was

here that Casanova wrote his famous *Memoirs*. He died at Dux on June 4, 1798.

**CASCADE AMPLIFIER**, an arrangement of electronic tubes (*see* TUBES, ELECTRONIC) and COUPLING circuits in which each stage amplifies the output of the preceding stage (*see also* AMPLIFICATION, THERMI-ONIC).

**CASCADE MOUNTAINS**, a complex range in the states of Washington and Oregon, lying parallel to the Pacific coast. On the east they overlook the Columbia plateau, on the west are separated from the Pacific coast ranges by the Willamette valley and Puget Sound lowland, and at the south terminate in California at about 40° 20' N. lat. where the Sierra Nevada begins. The general level of the mass varies from 4,000 ft. in the southern part to 6,000 and 8,500 ft. toward the north, and is dominated by a chain of snow-capped volcanic peaks which rise thousands of feet above the horizon. The wide northern section is composed of steep, rugged, granitic ridges except for Mt. Baker, 10,827 ft. and Glacier Peak, 10,436 ft., both volcanic peaks. Beginning with Mt. Ranier, 14,408 ft., the highest peak in the range, the remainder of the range is of volcanic origin and the most prominent cones are Mt. Hood, 11,225 ft., Mt. Adams 12,470 ft., and Mt. St. Helens, Jefferson and Pitt. In northern California the Cascades have no continuous crestline but consist of groups of cinder cones and several isolated peaks including Mt. Lassen, 10,437 ft. which erupted in 1914-15, and Mt. Shasta, 14,380 ft.

**CASCARA**, the dried bark of the trunk and branches of *Rhamnus Purshiana*. A laxative, acting mainly in the colon, which is widely used in cases of habitual constipation. Is employed chiefly as an extract or a fluidextract. *See also* CATHARTICS.

**CASCARILLA**, the bitter aromatic bark of a small tree (*Croton eluteria*) of the spurge family, native to the Bahama Islands and used in medicine as a tonic. When burning, the bark emits a fragrant odor, and, on this account, it is said to have been once mixed with tobacco for smoking. In South America the name cascarilla is commonly given to a variety of bitter medicinal barks, including cinchona bark.

**CASE, ANNA** (1893- ), American soprano singer, was born at Clinton, N.J., Oct. 29, 1893. She studied singing with Augusta Renard. In 1909 she made her debut at the Metropolitan Opera, New York, as a Dutch boy in Massenet's *Werther*. Later she sang Sophie in *Rosenkavalier*, Micaela in *Carmen*, Olympia in *Tales of Hoffman*, and made numerous concert tours. She married Clarence H. Mackay on July 18, 1931.

**CASE, ERMINE COWLES** (1871- ), American paleontologist, was born at Kansas City, Mo., Sept. 11, 1871. He graduated from the University of Kansas in 1893, studied at Cornell University and the University of Chicago until 1895. He was professor of geology and physical geography at the Wisconsin State Normal School, Milwaukee, from 1897 to 1906. He then became assistant professor of geology and paleontology at the University of Michi-

gan, gaining his professorship in 1912. While at Chicago Case had been a student under S. W. Williston and in later years was associated with him in work upon reptilian and amphibian paleontology. In the course of this work and later after Williston's death, Case discovered many important fossil forms intermediate between the reptiles and amphibians. He wrote *Geology and Physical Geography of Wisconsin* and several monographs and other contributions mostly on vertebrate paleontology.

**CASE**, that INFLECTION of the noun, adjective, or pronoun which indicates its relation to the other word or words in its sentence or clause. Theoretically, the number of cases may be very great, 30 being listed for the CAUCASIAN AVAR; but most of these are made merely by prepositions corresponding to *in*, *of*, *on*, etc., so that they do not properly fall within the definition of a case, whose termination can have no known meaning by itself.

The number of cases in the INDO-EUROPEAN singular, still retained in INDO-IRANIAN, was at least eight; nominative, vocative, accusative, genitive, ablative, dative, locative and instrumental. The nominative, usually defined as denoting the subject of the sentence or clause, seems to be rather the "active" case indicating the living being performing a certain act or being in a certain state, so that the neuter, as inanimate and hence inactive (*see* GENDER), would originally have had no nominative. The vocative, the "case of direct address," is in reality scarcely a case at all, since it stands in no syntactic relation to any other word. Except where it coincides in form with the nominative, it is identical with the simple stem of its noun, thus presenting a significant analogy with the second person singular imperative of the verb. Since it can properly be used only of active, animate beings or of things conceived as such, the inactive neuter has no special form for it. The accusative is not so much the "object case" as the "passive," as denoting the being or thing upon which action is exercised, and hence the masculine (active) accusative coincides in form with the inactive neuter. "Accusative" is a mistranslation, dating from the native Latin grammarians, of the Greek *aitiatiḱē* "causal," since the case was supposed to "cause" the action indicated by the verb. The genitive, also an awkward rendering of the Greek term *genikē* "generic," is conventionally supposed to be the "possessive case." In this sense, however, it is for the most part confused with the ablative; and there is also reason to suppose that as a possessive it was originally merely an indefinite or a stereotyped case of a substantivized adjective, as in Latin *cujus* "whose," which is in form a nominative singular masculine. It is likewise significant that the possessive genitive is practically equivalent to a possessive adjective, e.g., "the father's house" = "the paternal house." The primary force of the case seems to have been partitive, as still found notably in Greek, Lithuanian and French, e.g., French *donnez-moi du pain* "give me (some) of the bread." The ablative is the "from" case; the locative, the "in" case; and the in-

strumental the "with" case, whether of means or simple accompaniment. Usually considered the "case of the indirect object," the dative is, rather, expressive of interest or advantage (or disinterest, disadvantage), thus explaining the miscalled "dative of agent" of the conventional Latin grammars, e.g., *nobis liber legendus est* "the book must be read by us," "we must read the book," which primarily meant "for us (for our profit) the book is to be read."

Certain phenomena of ACCENT seem to indicate that only the nominative and accusative were primary cases, the remainder apparently having been ENCLITICS; and in all Indo-European languages except Indo-Iranian, the cases have more or less coalesced (a phenomenon called "syncretism"), so that Greek, Italic and Celtic (*see also* separate articles on these subjects) have only five distinct cases, GERMANIC six, and ENGLISH only three, with a trace of a fourth, the instrumental, in *the* in the type *the more, the merrier*.

SEMITIC has three cases: nominative, accusative and genitive, with scanty traces of a locative; but its so-called "construct case" is not strictly speaking a case, but rather the first member of a COMPOUND.

L. H. G.

**CASE HARDENING**, usually signifies the process of imparting a hard case to a steel article by means of CARBURIZING and HEAT TREATING, but may also be used with reference to CYANIDING and NITRIDING.

Case hardening by carburization is used where a hard case of considerable depth is required. A case over one inch deep may sometimes be required. Armor plate, for example, is case hardened as deep as 1¼ in. Automobile gears are case hardened from .035 to .060 in. deep. Besides the improved resistance to wear obtained by case hardening, strength is greatly increased. Case hardening of automobile and truck rear axle shafts is done with this sole object in view and it is recognized that a case hardened shaft will stand much higher loads without failure than shafts made of structural alloy steels. Nitriding is used where great depth of case is not required, but where extreme surface hardness and freedom from distortion is desired. Cyaniding is used on soft steels where a superficial surface hardness is adequate for resistance to wear from light loads and on harder steels where a combination of high strength and hard surface are desired such as in automobile transmission gears.

Case depth by nitriding may be obtained up to .040 in., but the treatment to obtain this is long, expensive and seldom used. Parts case hardened by nitriding are well suited for use at elevated temperatures, because the hardness of the nitride case does not diminish until a temperature over 1000° F. is reached. Carburized or cyanide cases soften above 400° F.

F. O. CL.; A. L. Bo.

**CASEIN**, the protein material which forms the curd in milk. Commercial casein is made from skim milk. The casein curd is precipitated by the addition of RENNET or by acid. The acid may be produced by the natural souring of the milk or sulphuric



or muriatic acid may be added. After the curd is precipitated, it is washed, pressed, dried and ground. The solubility and uses to which the casein may be put depend on the conditions of precipitation and washing of the curd. Commercial casein contains from 6 to 10% moisture, from 0.5 to 8% ash, and a trace of fat.

Wisconsin, California and New York lead in the production of casein. The total production in the United States was 30,000,000 lbs. in 1929, about an equal amount being imported.

A large amount of casein is used in coating paper to be used in half tone printing. Casein glue is marketed for use in the form of a dry powder which contains chemicals that readily convert it into a usable GLUE by the addition of water. Casein glue finds a variety of uses and is especially suitable for wood veneer gluing. It has pronounced water resistant properties. The best cold water paints contain casein as a binder, and, if properly made, are water resistant. They are very suitable for interior decorating. Casein is used as a binder in art plaster by means of which various roughened decorative effects are produced on interior walls. Casein is used in pharmaceuticals and as a stabilizer for emulsions particularly in insecticides.

Rennet casein is most suitable for plastic making. It is mixed with suitable dyes and a small amount of water. Under heat and pressure it becomes plastic. This plastic material is pressed into the form of rods or sheets and is then soaked in a formaldehyde solution which renders the casein insoluble. It is then dried. The finished product takes a very high polish.

Casein plastics are used in imitation of horn, ivory, celluloid, ebony, pearl, amber, turquoise, shell and for their own beautiful color effects. The casein plastic is used in making buttons, combs, knife handles, penholders and barrels, and art novelties of various kinds (see PLASTICS). P. F. S.

**CASEMATE**, a storeroom or compartment built into or connected with a fortification, protected from hostile observation and attack. The casemate is sometimes used as a MAGAZINE or as shelter and quarters for the defending garrison.

**CASERTA**, a city of Italy, 17 mi. northeast of Naples, in the province of Naples on the edge of the fertile campagna, the seat of a bishop. In 1752 the Bourbon king of Naples, Charles III, erected there a sumptuous summer residence, the Versailles of Naples, one of the greatest palaces in Italy, around which the city grew up. The palace is a huge rectangle with four courts, a colonnade through its entire length, a grand stairway, a richly decorated chapel and splendid chambers. About 2 mi. north of the new city lies the site of ancient Caserta Vecchia, founded by the Lombards. It has medieval buildings, the foremost being the Romanesque cathedral and campanile. Pop. 1931, 51,423.

**CASE SCHOOL OF APPLIED SCIENCE**, an institution for men founded at Cleveland, O., in 1880,

by Leonard Case, Jr., who left a trust fund for that purpose. The school comprises a college of engineering, with chemical, physics, mechanical, electrical and mining engineering laboratories, and the Warner and Swasey Observatory, containing a 10-inch equatorial telescope. The institution had an income from its productive funds in 1931 amounting to \$211,131. The library contains 22,444 volumes. In 1931-32 there was a student enrollment of 842, and a faculty of 76 headed by Pres. William E. Wickenden.

**CASE WORK**, a term as used in law and medicine meaning the particular circumstances affecting an individual. The word case has been in common use by lawyers and physicians from time immemorial. The lawyer adjusts the relation of his client to persons and property; the physician adjusts the body and mind of his patient to his environment; the priest applies the principles of casuistry which is the application of general moral rules to particular cases. Each of these three overlaps the special field of the other. Each of them deals with cases, cases of law, cases of illness and cases of conscience. Social case work includes them all and may use the lawyer, the physician and the priest. Social case work involves social diagnosis and social treatment. Diagnosis requires a study of the personality of the client as shown by the condition of his mind, body and estate present and past, including testimony of relations, friends and employers. Social treatment is the attempt to adjust the individual to his environment by modifying the environment or the attitude of the individual toward conditions which cannot be altered.

The New York School of Social Work for the training of social workers was started in 1898. The full course of two years is open to college graduates. There are about 28 similar schools in the United States. L. P.

**BIBLIOGRAPHY**.—Mary E. Richmond, *What Is Social Case Work?*

**CASH**, in ordinary business practice, comprises not only coin of the realm and all LEGAL TENDER currency, but CHECKS awaiting collection. Checks returned by bank as uncollectible are best treated as ACCOUNTS RECEIVABLE, although often held with the cash for deposit for the purpose of making another attempt at collection. Cash held abroad in branches or subsidiaries is usually to be shown as "Cash" on a consolidated balance sheet. For this purpose it is usual to convert such cash to home office currency at the rate of exchange (see FOREIGN EXCHANGE) prevailing on the date of the balance sheet.

**CASHEW** (*Anacardium occidentale*), a spreading evergreen tree of the CASHEW family native to tropical America and widely grown in tropical countries for its various valuable products. The tree, 20 to 40 ft. high, bears leathery leaves and small yellowish-pink flowers. The fruit is a kidney-shaped nut, borne at the end of a fleshy edible receptacle. In the hard double shell of the nut there is an acrid oil that must be roasted out before the nutritious kernel is extracted. The kernels, which are the cashew nuts of commerce,

yield a sweet oil of excellent quality. The tree also produces a milky juice used for varnishing and a gum similar to gum arabic.

**CASHIER'S CHECK**, a check of which a bank is both the drawer and drawee, it being signed by the bank's cashier. Such checks may be purchased at face value plus a small service charge for use in payment of private debts. They are frequently used by banks in meeting their own obligations.

**CASHMERE**. See KASHMIR.

**CASH ON DELIVERY**, a term, usually abbreviated C.O.D., used to denote a system of buying goods in which they are paid for upon delivery. In case payment is not made the delivery agent returns the goods to the seller upon receipt of his fee. The Post Office Department acts as a C.O.D. Agent and most large retail houses offer its customers that service.

**CASH REGISTER**, a development of the adding machine used in retail stores and the like for recording and summing up the various amounts of money placed in the cash drawer. As the keys are pushed to register the sale the cash drawer opens, an indicator rises to show the amount of the bill to the customer and a record is made under lock and key.

**CASINO**, a card game for two, three, or four players, in which a full deck is used. The cards rank from king to ace. Four cards are dealt in twos to each player, and four cards are placed face upwards on the table. The object of the game is for each player to take as many cards as possible. Tricks are taken by matching cards in the hand with those of equal denomination on the table. Combinations may be formed by adding, for instance, an ace and a five-spot to be taken with a six in the player's hand. Since only one card can be played at a time, it is possible to build a sequence, to be taken at the player's next turn. If a player makes a sweep, taking all the cards on the board with one card, it counts one. The first player, or partners, to score 21 points wins the game. Points are reckoned as follows: the greatest number of cards, three; greatest number of spades, one; the 10 of diamonds (big casino), two; two of spades (little casino), one; aces, one each. Face cards generally have no valuation; but in some games, they may be counted kings, thirteen; queens, twelve; and jacks, eleven.

**CASKET LETTERS**, the name applied to eight letters and some French verses in the handwriting of Mary, Queen of Scots, that were taken from a retainer of the Earl of Bothwell, June 20, 1567, six days after Mary's surrender at Carberry Hill. Their authenticity has been the subject of much controversy. If genuine, they prove the complicity of Mary in the murder of her husband, Henry, Lord Darnley. Even if they were tampered with, they still show the infatuation of the Queen for Bothwell, one of his murderers. Among those who have tried to solve the problem of their authenticity, are John Hosack in his *Mary Queen of Scots and Her Accusers*, 2nd ed. 1870-74; T. F. Henderson, *Casket Letters and Mary, Queen of Scots*, 2nd ed., 1890; Andrew Lang, *The Mystery*

of *Mary Stuart*, rev. ed., 1904; and R. H. Mahon, *Indictment of Mary, Queen of Scots*, 1923, and *Mary, Queen of Scots, A Study of the Lenox Narrative*, 1924.

**CASKODEN, EDWARD**. See MAJOR, CHARLES.

**CASLON, WILLIAM** (1692-1766), a type founder born in England. In 1716 he established himself in London, where he engraved guns and made tools for book binders. Drawn thus into the book trade he designed his own fonts of type and set up a type foundry. His type shortly became the standard of the best English printing and only dropped out of use early in the 19th century, to be revived again more recently.

**CASPER**, a city and the trade center of central Wyoming, the county seat of Natrona Co., situated on the North Platte River, 200 mi. northwest of Cheyenne. It is served by two railroads. There are important oil and gas fields in this region, including the famous Teapot Dome and the Salt Creek fields. A great many sheep are raised in the district. Natural gas and oil wells are in the region, and oil refining is the principal local industry. There are sodium and asbestos mines. In 1929 the retail trade amounted to \$14,050,385. Casper Mountain Park and Ft. Casper are in the vicinity. The city of Casper was incorporated in 1889. Pop. 1920, 11,447; 1930, 16,619.

**CASPIAN SEA**, the largest tideless inland sea in the world, situated on the boundary between Europe and Asia. Its length from north to south is about 680 mi.; its breadth varies between 150 and 270 mi.; the total estimated area is 170,000 sq. mi. The principal rivers flowing into it are the Volga, Terek, Urah and Kur. As there is no outlet, the water is salt, ochre in color and without ebb or flow. The Caspian abounds in shallows which make navigation difficult. There is water communication with the Baltic Sea via canals and the Volga. The chief ports are Astrakhan, Baku, Derbend, Astrabad and Krasnovodsk. Fisheries are valuable; sturgeon, roach, bream, carp and perch are plentiful, and seal and porpoise occur.

**CASS, LEWIS** (1782-1866), American statesman and soldier, was born at Exeter, N.H., Oct. 9, 1782. After attending Exeter Academy, he moved to Ohio, and in 1802 was admitted to the bar. He served with distinction in the War of 1812, and at the end of hostilities held the rank of brigadier-general. In 1813 he received an appointment as Governor of the Territory of Michigan. Ever a strong expansionist, he managed to acquire during 18 years as governor, vast tracts of land for the United States through treaties with the Indians. Jackson appointed him Secretary of War in 1831, and he later spent six years in Paris as U.S. minister. Elected United States Senator in 1845, he resigned in 1848 to run for President as the Democratic candidate, but after the election of Taylor returned to the Senate the next year and remained there until 1857. As senator, he fought the Wilmot proviso calling for exclusion of slavery in newly acquired territories and supported the Compromise Measures of 1850 and 1854. Cass was made Secretary of State in 1857 but resigned in 1860 when Buchanan refused to increase the strength of the Federal

garrison at Fort Sumter. Thereafter he devoted himself to literary pursuits until his death at Detroit, June 17, 1866. In addition to articles which he contributed to the magazines of his day his writings include: *Inquiries Concerning the History, Traditions and Languages of Indians Living Within the United States*, 1823, and *France: Its King, Court and Government*, 1840.

**CASSABA** (*Cucumis Melo*, var. *inodorus*), a winter muskmelon introduced into California from Asia Minor in 1878, and now largely grown in the San Fernando Valley. Cassabas are smooth-skinned, golden melons about 8 in. in diameter, with thick, sweet, yellow or creamy flesh, becoming full-flavored only when "dead ripe." Harvested usually in November and December, they keep, under proper conditions, for many weeks.

**CASSANDRA**, in Greek mythology, daughter of PRIAM and HECUBA. APOLLO, loving her, gave her the gift of prophecy, but when she did not fulfill his wishes he added the curse that she should never be believed. She foretold the fall of Troy in vain. In the siege of this city she was ravished by AJAX, and when the city was plundered, fell to the lot of AGAMEMNON. She was murdered by Clytemnestra.

**CASSATT, MARY** (1845-1926), American artist, was born in Allegheny City, Pa., May 22, 1845. She studied painting in Parma, Italy, in Spain and at Antwerp. In 1874 she returned to Paris, where she became a disciple of Degas, and exhibited with him and his friends of the Impressionist School. She gave her first independent exhibition in 1893 in Paris, and was chosen among the women artists to decorate the Woman's Building in the Chicago Exposition. Her best portraits are those of her mother and of Mrs. Henry O. Havemeyer. Her pictures, mostly based on the theme of motherhood, are done in an original and simple manner. By many critics she is esteemed the most distinguished etcher, after Whistler, that America has produced; she is also noted as a pastellist. Cassatt is represented in the leading museums of America. She died at Mesnil-Théribus, France, June 14, 1926.

**CASSAVA** (*Manihot utilisima*), called also manioc or mandioc, a valuable economic plant of the spurge family native to Brazil and widely cultivated in tropical countries for its starch-bearing roots from which Brazilian arrow-root, tapioca and other food products are prepared. Cassava is a perennial, semi-herbaceous shrub with an abundant milky juice. In appearance it resembles the castor-oil plant, growing 3 to 9 ft. high, with large, deeply lobed leaves, small flowers in clusters, and globular, wing-angled seed capsules. In the large, fleshy roots, 3 to 9 in. in diameter and sometimes 3 ft. long, there is usually more or less prussic (hydrocyanic) acid, often in sufficient quantity to render them deadly poisonous when raw. The poison, however, is made harmless by pressing out the juice and heating. The varieties containing the most poison are commonly called bitter cassava, and those with the least acid sweet cassava.

A related non-poisonous species (*M. Aipi*), likewise known as sweet cassava, is also widely planted. Cassava, in tropical countries, occupies a position as a root food similar to that of the potato in temperate regions. In Florida and other parts of the extreme South cassava is sparingly grown, mostly for stock food.

**CASSEL**, capital of the Prussian province, Hesse-Nassau, situated on the Fulda River about 8 mi. below the junction of the Eder. Before 1866 it was capital of the Electorate of Hesse-Cassel. The winding streets of the old city, with its timber-framework houses around the market place on the high western bank, contrast strongly with the wide streets and spacious gardens made possible by the demolition of ancient fortifications. There are numerous squares with imposing public buildings and palaces of comparatively recent date. Though mentioned in 913, Cassel's importance began only after the arrival of the Huguenots after 1686, who gave impetus to industry, aided by the proximity of lignite. The picture gallery with over 800 paintings, including works of Rembrandt, ranks with those of Munich and Dresden. The industry of the city includes the manufacture of scientific apparatus, railway coaches, textiles, porcelain, cigars and cast-iron. Pop. 1925, 171,234.

**CASSIA**, a large genus of herbs, trees, and shrubs of the PEA family. There are about 400 species, chiefly in the tropics, but extending into most temperate regions, except Europe, about 15 occurring in the United States, chiefly in the South. Many species, including various sennas and the pudding-pipe-tree, are medicinal. Others are cultivated as ornamentals for their handsome, finely divided foliage and showy, bright yellow or rose-colored flowers. Among the woody species planted for ornament are the well-known showy cassia (*C. corymbosa*), a native of Argentina, grown as a tub plant, and the pink-shower (*C. grandis*), a tree 50 ft. high, native to tropical America, grown in the open in southern California.

**CASSINI'S OVAL**, a type of LEMNISCATE. The equation is  $(x^2 + y^2)^2 = 2a^2(x^2 - y^2) + b^4 - a^4$ .

**CASSIODORUS, FLAVUS MAGNUS** (c. 480-575), Roman statesman, writer and monk. He held important offices under Theodoric, king of the Ostrogoths. Retiring at the age of about 65 years, he went to a Benedictine monastery in Calabria, which he himself had founded in 529. Here for more than 25 years he encouraged the pursuit of scholarship among his monks, their two tasks being the copying of manuscripts gathered by him and the translation of Greek writings into Latin under his supervision. At the same time Cassiodorus devoted his energies to the composition of historical, grammatical and theological works. Among his writings are the *Variae Epistolae*, official letters which afford intimate glimpses of the reign of Theodoric, the *De Anima*, the *Institutiones divinarum et saecularium litterarum*, *Historia Tripartita*, a compilation based upon Eusebius and Sozimus, and *Historia Gothorum*, which is now known only as the basis for the work of Jordanes.

**CASSIOPEIA** (gen. *Cassiopeiae*), one of the most brilliant of northern constellations, so named after the legendary queen of Ethiopia. Its five principal stars, of which three are of the second and two of the third magnitude, have the shape of a W. If a sixth star is added, resemblance to a chair may be seen. Among the points of interest may be cited Eta Cassiopeiae, a double star system, 18 light years distant, in which a star 30 times fainter than the sun revolves around one just equal to the sun in 340 years at an average distance of 5,000 million miles. Mu Cassiopeiae, almost equal to the sun in brilliance, is 25 light years from us and has a speed of 100 miles per second. See *STAR: map*.

**CASSIOPEIUM.** See *LUTECIUM*.

**CASSITE**, an extinct language spoken by the Cassites who ruled Babylonia from 1750 to about 1173 B.C. Knowledge of it is based on a Cassite-Babylonian (Semitic) vocabulary written in *CUNEIFORM*, but recording only proper names of deities, rulers and high officials. It was possibly a member of the *CAUCASIAN* linguistic family.

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**CASSITERITE**, the most important *ORE* of tin. It is brown, black or red, and sometimes gray or yellow in color, with a stony appearance. Varieties are tin-stone, massive or crystalline; wood tin, usually botryoidal with a concentric structure and in appearance resembling wood; and stream tin, in water-worn pebbles or grains. Cassiterite is the oxide of tin, and is also found in well-formed, tetragonal crystals, often knee-shaped due to twinning.

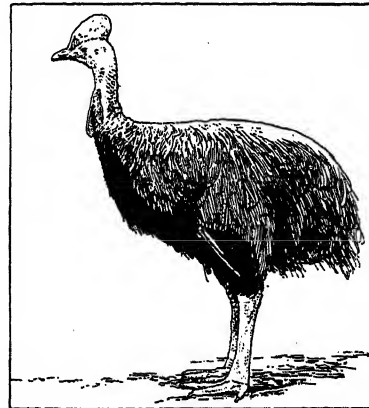
Cassiterite occurs occasionally in some *IGNEOUS* Rocks, pegmatites and a few contact metamorphic deposits. Its principal source is in veins of deep-seated origin with *STANNITE*, *CHALCOPYRITE*, *WOLFRAMITE*, *SCHHEELITE*, *QUARTZ*, *TOURMALINE*, *TOPAZ* and *FLUORITE*. Probably the largest known deposits are the tin and copper veins of Cornwall. Bolivia is an important source of tin, and a great deal is derived from the Malay archipelago, where placer deposits of stream tin are important. Some tin veins are known in North and South Carolina, Washington, South Dakota, Texas and Alaska. Tin is used for plating other metals and in the manufacture of tin ware, tin foil, bronze and other alloys. See also *TETRAGONAL SYSTEM*; *ORE DEPOSITS*; *QUARTZ*; *PEGMATITE*.

**CASSOCK**, also called soutane, a long, closely fitting garment worn by clergymen, with a standing collar and narrow sleeves, and closed from top to bottom down the front by buttons placed at very short intervals. It is worn during divine service with the appropriate vestments and at other times also. In the case of cardinals the cassock is scarlet; of bishops and domestic prelates, violet; of the pope, white; and of all other clergy, black. The girdle worn with it is of the same color. The Lateran Synod of 1215 forbade colored garments except in religious services and

Pope Sixtus V especially confirmed the use of the long black cassock.

**CASSON AND GALINEE, EXPLORATIONS OF.** With the authority of the Seminary at Montreal, two Sulpician missionaries, Francis Dollier de Casson and René de Brehant de Galinee, in 1669 accompanied LA SALLE on his expedition westward, with intent to establish a mission among the Shawnee. The expedition met JOLIET in September; on his advice the Sulpicians decided to visit the Pottawatami Indians on Lake Michigan. The missionaries with seven French servants wintered on Lake Erie at the present Port Dover, and on Mar. 23, 1670, took ceremonial possession of the lake and regions adjacent in the name of Louis XIV. Setting out westward they encountered great hardships, and at Point Pelee lost all belongings, including the altar service. Since they could not, therefore, administer nor receive the sacrament, they decided to return to Montreal by way of the Lake Nipissing-Ottawa River route. Up the Detroit River, Lake St. Clair, and Lake Huron, they proceeded to Michilimackinac and thence to Sault Ste. Marie. Having missed the spring flotilla of the Ottawa Indians, they hired a guide, took leave of the Jesuit mission at Sault Ste. Marie on May 28, and in three weeks were at Montreal. Galinee mapped the region at TALON's request; this map, the first one of the lakes made first hand, was valuable in its detail.

**CASSOWARY**, a genus (*Casuarius*) of very large flightless birds allied to the ostriches and emus, and native to wooded districts in Australia and the Papuan Islands. They are somewhat smaller than the ostrich, though some stand 5 ft. high. With black hair-like plumage, brightly colored head and neck,



CASSOWARY

and a curious bony helmet on the forehead, these birds present an odd appearance. Like the ostrich they are exceedingly swift of foot. They feed chiefly upon vegetable matter, fruits and insects and usually nest in dense undergrowth, laying 5 to 8 rough-surfaced eggs, sometimes 6 in. long. As in the case of the emu, the male hatches and rears the young. In their native haunts cassowaries are shy, sullen and pugnacious but in captivity they become very tame.

**CASTANETS**, a pair of spoon-shape shells, either of ivory or hard wood, attached to the thumb and beaten together by the action of the middle finger. They are used almost exclusively in dance music.



CASTANETS

The origin of the name is the Spanish *castaña*, or chestnut, the shell of which probably was the material used in the primitive castanets.

**CASTES**, the divisions of Hindu society in India. The caste system probably was introduced into India by the Aryan peoples who came

down into the country from the north and northwest in a series of invasions approximately between 2400 and 1500 B.C. These Aryans made two principal divisions in the community; one including themselves, called the "twice born"; the other including the pre-Aryan inhabitants of India whom they conquered, and called the "once born." Among the Aryans there were three divisions: the Brahmins or priests, the Kshatriyas or warriors, and the Vaisyas or common people. Of these the Brahmins were considered to be the highest, and the Kshatriyas next. The conquered peoples were called Sudras. This division into three castes of the "twice born" and the one great group of castes of the "once born" remains to-day, as does the order of the "twice born" castes.

Through the centuries, many new castes have developed, particularly among the Sudras or "once born." There are now some 2,400 different castes. These caste distinctions are largely economic in origin, the tendency being for those who engaged in the same occupation to be marked off as a separate caste. The occupational castes have again been sub-divided geographically, those in different regions though in the same occupation forming separate castes. In many cases the members of a caste have functioned together substantially as a trade guild.

Religious tabus have grown up which emphasize the caste divisions and lay down strict rules as to the kinds of things the members of the different castes may do. It is extremely difficult for an individual to pass from the caste into which he is born into another caste—except as he may be ousted from the caste altogether and become an "out caste." These caste divisions form one of the most serious obstacles to the establishment of national unity in India.

**CASTIGLIONE, BALDASSARE** (1478-1529), Italian author and statesman, was born at Casanatico, near Mantua, in 1478. His principal work, *Il Cortegiano*, written in 1514, is one of the landmarks of European prose literature of the 16th century. He also wrote poetry of exquisite beauty in Latin and Italian. Castiglione died at Toledo, Spain, Feb. 7, 1529.

**CASTILE**, a kingdom in the northern part of the Iberian Peninsula, originating in the 11th century, and bounded by the Bay of Biscay on the north, Navarre and the Basque provinces on the northeast, Aragon on the east, Murcia and Valencia on the southeast, Andalusia on the south, Estremadura and Leon on the west, and Asturias on the northwest.

The kingdom of old Castile arose in 1032 when the King of Leon bestowed the county of Castile upon his son, Fernando. Successive rulers maintained constant war against the Moors, and finally captured Toledo and other districts in 1085. In this same year the recovered territory, consisting of the provinces of Ciudad Real, Cuenca, Guadalajara, Madrid and Toledo, was combined to form New Castile. In 1230 the crown of Leon passed to Ferdinand III of Castile, which then included both New and Old Castile. In 1474 Isabella became Queen of Castile. In 1492 the Castilians drove the remaining Moors out of Granada. The language of Castile became the literary tongue of Spain, because of the social and cultural importance of the kingdom. Out of the personal union of Castile and Aragon through the marriage of Isabella and Ferdinand, King of Aragon, was formed a united Spain.

**CASTILHO, ANTONIO FELICIANO** (1800-75), Portuguese poet, was born at Lisbon in 1800. Although blind from his 6th year, he studied law at Coimbra, and in 1821 attained fame with *Letters from Echo to Narcissus*. Political misfortunes sent him to exile in the Azores, till on a change of government, he returned to Lisbon, and was made a viscount, and Minister of Public Instruction. Castilho died at Lisbon, June 18, 1875.

**CASTILLA, RAMON** (1792-1867), Peruvian soldier and statesman. He served in the wars for independence and in subsequent revolutions. In 1845 he was elected president of Peru for a six-year term, establishing peace in the country after a long period of unrest. He stabilized finances and consolidated the national debt with the income from the guano deposits of the Chincha Islands, and promoted telegraph, railroads and other public works. In 1855 he began a second term of office, during which he continued the same policies, but internal disorders and trouble with Ecuador disturbed the peace he had established. At the end of the second term, he retired from office, but continued to be active in politics until his death.

**CASTING** or founding consists in the production of castings by pouring molten metal into molds. The commercial metals are the ZINC alloys, ALUMINUM alloys, BRASSES and BRONZES, CAST IRON and malleable iron, and CAST STEEL. The mold is usually made in sand although metal molds are used in die casting and in permanent mold work. A pattern is a wooden or metal counterpart of a casting to be made. A core is a shape made in sand to form a cavity in a casting. A mold is a body of rammed sand containing a cavity made by a pattern, and the necessary cores, which when filled with molten metal yields a casting of the desired shape. Castings are cleaned by sand blasting, chipping and grinding.

The foundry has met the demands of industry through improvement in strength and workmanship of castings and also by improved technique as by the use of X-ray machines for detecting hidden defects. Cast iron castings have increased in strength



through the use of steel in the mixture, and the addition of nickel, chromium, molybdenum, calcium silicide, and the pouring of low carbon iron into heated molds (pearlitic iron). Chilled iron castings for steel mill rolls and car wheels have been steadily improved. Higher strength has been obtained in steel castings through the use of alloys and heat treatment. A notable example in the production of a steel casting is the bed for a locomotive in which the two main frames, cross ties, cylinders, and boiler saddle are cast in one integral steel casting.

Centrifugal casting has assumed major importance in the production of cast iron pipe, in large cylindrical shapes in bronze, and in the making of 75 mm. and 155 mm. guns in steel. The "sand slinger" which throws the sand with considerable force and at high speed around the pattern to form the mold has speeded production. In DIE CASTING, metal is poured under pressure into metal molds. This method is practiced on a large scale in the production of castings from the zinc and the aluminum alloys. Mechanical sand handling, roller conveyors for molds, and overhead trolleys for transporting the metal have combined to increase the efficiency of the foundry. Electric furnace cast iron is an important development. S. R. R.

**Processes for Casting Bronze Art.** There are two processes used in the casting of bronze, the lost wax or gelatine mold process, a version of which was used by the ancient Greeks; and the sand mold process, which is of more recent development. In the lost wax process, a negative is made by coating the object to be cast with plaster or gelatine. When the coating is dry it is removed from the model, and the impression is covered with a layer of wax approximately one-quarter of an inch thick. When the wax has hardened, the negative is removed and a mixture composed of silica, plaster and heat resisting chemicals is poured around the wax. When it in turn has hardened, the wax is melted away. It is general practice to weigh the wax before it is applied to the negative and again when it is melted out of the mold to make sure that no wax remains in the mold to ruin the casting. The mold is packed in foundry earth, and molten bronze is poured in through gates to fill the space left by the "lost" wax. The casting is finished by polishing with pumice stone.

For the sand mold process, a negative is made in French sand surrounded by an iron frame called a flask. This French sand is of so fine a texture that it registers the lightest impressions. To date it has been found in only one place in the world, a little village on the outskirts of Paris. If the object to be cast has undercuts, such as ears, eyes and folds of drapery, the negative must be made in small sections, or cores, which are carefully numbered and fitted together. An inner core of coarser sand is made so that the finished casting will not be more than one-fourth to three-eighths of an inch in thickness, the maximum thickness in which bronze will cool evenly and not distort the mold. In a large casting the molten metal is admitted simultaneously through several gates so

that it fills the entire mold at almost the same instant. To be right for pouring, the bronze must be between white heat and a dull red or approximately 1,900 degrees Fahrenheit. The crucibles in which the bronze is melted and carried to the mold are made of graphite, sometimes called plumbago or black lead. Surplus metal in the mold, like water seeking its own level, ascends through vertical channels called risers. When metal reaches the top of these channels, it indicates that every part of the mold has been filled. When cool, the casting is dug out of the burnt sand and the bronze which filled the risers and gates is cut away. Bronze cast in this way needs much more finishing than in the lost wax method. The casting is placed in an acid bath to remove all sand particles, and it is then gone over by filers and chasers who remove the rough burr and any seams or other irregularities.

Indoor pieces are frequently finished with lacquer. Outdoor pieces are oxidized with chemicals to subdue the bright gold color of new bronze. The first bronze statue to be cast in the United States was that of Dr. Bowditch, the astronomer, cast in 1847 by Ball-Hughes. It was later recast in Paris.

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**CAST IRON**, a term given to PIG IRON, after it has been melted and poured into molds. It has a coarse crystalline structure, low tensile strength and a very high compressive strength. It melts readily and is easily cast into a variety of shapes. Cast iron contains about 1.5% carbon. In gray cast iron this is almost wholly in the graphitic state, due to the presence of silicon. If the silicon is oxidized the free carbon combines with the iron, producing white cast iron. By heating ordinary cast iron at a temperature of 700-800° C. in the presence of an oxide of iron, malleable iron is produced.

**CAST-IRON PLANT**, the name sometimes given to a hardy pot and window-garden plant (*Aspidistra elatior*) with stiff evergreen foliage, because of its ability to endure unfavorable conditions and rough usage. *See also* ASPIDISTRA.

**CASTLE AND CHATEAU.** Although the words are etymologically identical, being respectively the English and French derivatives from the Latin *castellum*, the course of history has brought a distinction between the two. By definition, a castle is a small self-contained fortress, usually of the Middle Ages, and ordinarily a private residence, as opposed to the municipal citadel. The word is sometimes applied to the house of a lord or a prince, even if unfortified, but such usage commonly denotes a direct feudal survival. Chateau, on the other hand, is used by the French to denote any country house with some pretension to size and elegance. It may be feudal or royal or even of the bourgeoisie, and may belong to the Middle Ages or the Renaissance or a later period. In ordinary usage, in English, it follows that architecturally we apply the word castle to defensive and feudal dwellings anywhere, and the word chateau to unfortified and Renaissance country palaces on the

continent of Europe. The 13th century Chateau of Beynac on the Dordogne, for example, is translated into the English tongue and called a castle. The 16th century Chateau of Azay-le-Rideau in the Loire country is never designated, in English, by any other word than chateau.

The earliest type of medieval castle was a simple and massive rectangular structure, built on a heaped up earthen mound or a natural elevation, and surrounded by a timber palisade, and below this a moat. Such a castle was the product of the insecurity of the Dark Ages, and the quickness with which the palisade, and even the keep, could be built and rebuilt was one of its advantages. This kind of castle is pictured in the Bayeux tapestry, and was common on the continent and in England up to the 12th century. It was built primarily for passive defense, and could usually be provisioned for a long siege. But it was very practical as a base for offensive sallies. It concentrated its resistance at the inner keep and made small compromise with comfort. By the 12th century improved methods of attack were rendering it increasingly vulnerable. The Crusaders, moreover, brought home tales of superior fortresses Beyond-the-Sea. A new and revolutionary development may be seen in the plan of Chateau Gaillard, built in 1197, by Richard the Lion-hearted of England, on a hill above the Seine in Normandy. Followed in innumerable feudal strongholds throughout western Europe and perfected in the great castle of Coucy, near Noyons, 1223-30, this plan remained the type of medieval castle until the introduction of gunpowder brought in siege artillery.

Such castles as Chateau Gaillard, Coucy, and the others were planned and built upon the principle of the mutual defense of all the parts of the fortification. They were complicated structures, and in their period well-nigh impregnable. Wherever possible, they were built in positions of natural strength. The ideal situation was on a point of land above the meeting of streams. The castle walls and buildings were arranged in a more or less triangular plan, most strongly defended on the side of easiest approach. The castle was protected, and in part or whole surrounded, by a double or triple rampart, the salient points of which were defended by towers. These, at first square, were generally built round after the end of the 12th century. The outer wall was encircled by a moat, and must be entered over a drawbridge and then through a portcullis gate. Each line of fortification was more difficult to capture than its predecessor; and at the center, or point of the triangle, stood the mighty round keep which was almost unconquerable.

Under the feudal system it was necessary for the lord to house a personal army within his castle walls, and also to keep horses and maintain the food and other services to withstand siege. The outer ward, or bailey, of the castle was given over to these necessities, and contained workshops, stables, storehouses and the like. Beyond the next enceinte was the lord's

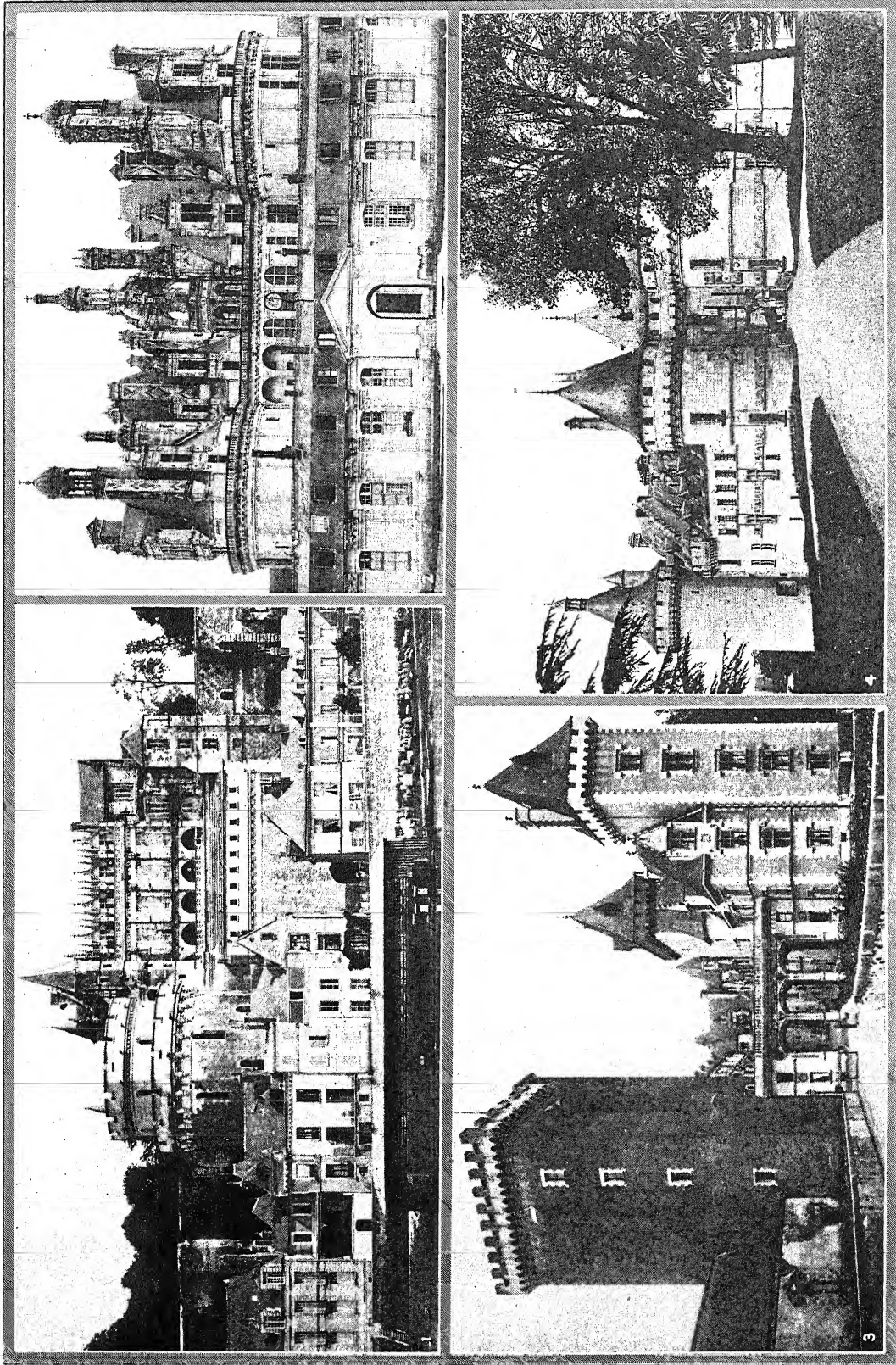
personal courtyard, and in that was the palace, the owner's residence, alongside of or connected with the mighty keep. Every tower, moreover, was a little fort in itself and could house and feed its garrison. Most castles had their own chapels within the walls. The keep of Coucy, which was probably the finest specimen of medieval military architecture in Europe before its destruction by the Germans in 1917-18, was 210 feet high and 100 feet in diameter, and the walls were in some places 34 feet thick.

The earliest castles relied upon solidity and advantageous situation for their defense. Improved implements of attack brought innovations added for a purpose far other than ornamentation: the machicolated *chemin de ronde*, and parapet over the entrance, through which boiling oil and pitch could be poured down; the crenellations or battlements of the towers to make firing easier and safer; the *meurtrières* through whose narrowed slits the defenders could attack the enemy without weakening the long curtain wall.

Gunpowder was first used in the 14th century, and artillery became formidable in the 15th. By the 16th century the feudal stronghold was no longer efficacious, and with its mighty castle feudalism itself declined. Chateau architecture changed totally, yet not abruptly. Windows became wider and were used in the lower stories. Such details as machicolations and entrance gates were retained as decoration. Many a castle added a Renaissance wing. The range of architectural development, from feudal keep to palatial manor, may be studied in France in the valley of the Loire, where a few medieval fortresses are still standing amid luxurious Renaissance chateaux; and in the valley of the Dordogne, where a few Renaissance and late Gothic chateaux have been built in a countryside of feudal castles. And in both these districts, as elsewhere over Europe, are castles so built, altered and added to, as to present integrated examples of transition. One of the best of these is Langeais in Touraine, built in 1464, where massive towers flank the portcullis gate, but where the *chemin de ronde*, machicolated on the outer surface, becomes in the court no more than a cornice, and the walls of the towers themselves have been set with Renaissance windows. An exceedingly interesting blending of early feudal and late Gothic chateau architecture is seen in the castle of Josselin in Brittany.

The typical Renaissance chateau is before all else beautiful. The heavy machicolations are converted into a cornice which is a crown, and over which the high dormers lift pinnacles like jeweled fretwork. The corner watch-towers have become light and graceful, the flanking towers of the entrance have been changed to charming tourelles. One of the earliest introductions of Renaissance architecture into France is seen in the Louis XII wing of the Chateau of Blois, 1503. Azay-le-Rideau in Touraine, 1516, is the type of the French Renaissance chateau at its purest and best; virtually untouched by Italian influence, it keeps from the feudal period only enough

## CASTLE AND CHATEAU



1, COURTESY FRENCH LINE; 2, 3, 4, RAILWAYS OF FRANCE

### TOWERS AND BATTLEMENTS IN THE CHATEAU COUNTRY OF FRANCE

1. Chateau at Amboise in Touraine, overlooking the Loire. According to tradition, 1,200 conspirators in the plot to remove Francis I from the influence of the Guises were slaughtered here in 1560.
2. Chateau of Chambord near Blois, dating from the 15th century, one of the finest of Renaissance palaces.
3. Chateau of Henry IV at Pau, in the French Basque country.
4. Chateau of Chaumont near Blois, built by Charles d'Amboise at the end of the 15th century.

mainly in India. In the United States it is planted chiefly as an ornamental, valued for its highly decorative foliage, and has run wild from New Jersey to Florida and California.

**CASTREN, MATTHIAS ALEXANDER** (1813-52), Finnish philologist and traveler, was born at Tervola, near Tornea, Dec. 2, 1813. He traveled extensively in Lapland, northern Russia and Siberia and studied the languages spoken in those regions. His most important literary work is his translation into Swedish of the *Kalevala*, the national epic of Finland. He died at Helsingfors, May 7, 1852.

**CASTRO, CIPRIANO** (c. 1861-1924), Venezuelan dictator, was born at Capacho, Venezuela, about 1861. During a revolutionary period in his country he seized the Presidency in 1899. When in office he assumed dictatorial authority and by confiscations of property and indifference to National debts involved Venezuela in difficulties with the United States and other countries. In 1908 he went to Europe, and while gone his power was usurped by JUAN VICENTE GOMEZ. He intrigued to regain it but failed. Castro died at San Juan, Porto Rico, Dec. 4, 1924.

**CASTROP-RAUXEL**, a German city in the Prussian province of Westphalia, located about seven mi. northwest of Dortmund. It has mining and other schools, large quantities of minerals, and cement and chemical factories, distilleries and cattle markets. Electric street railways unite it with nearby cities. Obercastrop and Behringhausen united in 1902, forming Castrop, which, in 1926, merged with Rauxel and four other towns, forming Castrop-Rauxel. Castrop is at the head of the Heinrichsburg shiplifting plant on the Dortmund and Rhine Canal. Pop. 1925, 53,434.

**CAST STEEL** is made from cast iron by the BESSEMER and OPEN HEARTH processes, generally by the latter. Cast steel has a lower carbon content than cast iron; a medium grade with a tensile strength of 60,000-70,000 lbs. per sq. in. has the following analysis: .2-3% carbon, .5-75% manganese, .05% phosphorus, .05% sulphur, .25-35% silicon. Steel castings should be annealed to remove casting strains. Where strength is required as in gun mounts, stern frames of ships, rudder quadrants and various machine parts, steel castings are often used. See also IRON AND ITS ALLOYS.

**CASUAL LABOR**, that which is hired for short periods, with little or no discrimination. Usually unskilled or semi-skilled, the casual worker is hired at the peak of industrial activity and discharged in slack season, with no definite expectation of re-employment. The type is perhaps best illustrated by the wharf and dock laborer who loads and unloads ships. Casual labor should be distinguished from seasonal labor such as the skilled workers in the BUILDING INDUSTRY, who are selectively chosen and with a degree of certainty of employment, but who may work irregularly and often on short jobs for a number of different employers during the season. Around seasonal industry, however, there may develop large reserves of casual, semi-skilled or unskilled workers only intermittently needed.

In its strictest sense, casual labor does not include migratory workers such as those in construction gangs and in the harvest fields, with their special problems; it is limited to non-migratory groups called upon often enough to keep them from migrating but not often enough to enable them to make a decent living.

Casual labor is an outgrowth of our complex industrial system, in which each producer, subject to individual fluctuations in demand, hires extra "hands" during his busy periods. Other producers, whose busy season may or may not coincide, do the same. As a result, a reserve pool of unskilled or semi-skilled labor tends to accumulate from which employers may draw at the peak of production. Such reserves are, therefore, rarely completely employed. They are not unemployable, and their work is not superfluous; they are a permanent group of under-employed laborers.

There are some casuals in most industries, but casual labor is a problem only where the demand for labor is subject to especially wide fluctuation, such as building, longshore work, canning, LUMBERING and some lines of AGRICULTURE.

Irregular work and insufficient earnings are the lot of the casual. The unfortunate conditions under which he works breed shiftlessness and a resentment toward society which make him a ready adherent of radical theories. (See RADICALISM.) His interest is centered in no particular industry and the conservative methods of the orthodox labor unions (see LABOR ORGANIZATIONS) make no appeal to him. The conditions under which he works make organization difficult. With the exception of longshoremen and building laborers, there has been little headway made toward permanent organization, such organization as exists being of the militant type exemplified by the INDUSTRIAL WORKERS OF THE WORLD.

Increased mechanization of industrial processes in which casuals are employed, regularization of business operations, establishment of public EMPLOYMENT EXCHANGES, reduction of seasonality, and various devices for reduction of the numbers of new recruits who swell the ranks of the casuals, as well as the elimination of peaks and depressions of production, are tending toward partial elimination of casuals. P. F. B.

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**CASUARINA**, a genus of curious trees, native to Australia and the Pacific Islands, furnishing valuable timber and widely grown in warm climates as ornamentals. There are about 25 species, comprising a distinct family (*Casuarinaceæ*) of flowering plants. In appearance they resemble gigantic horsetails, the erect stem bearing threadlike, jointed, drooping branches, which serve as foliage, there being no true leaves. The male flowers are borne in slender spikes, but the female flowers are collected into dense heads, which ripen into woody cones enclosing the seeds. Several species, including the beefwood (*C. equisetifolia*), are grown in the southern states and in California. See also BEEFWOOD.

**CASUISTRY**, a term that signifies thinking according to cases. If it were proper to refer to it as a



science it might well be designated as the science of cases. It represents an overrefined, meticulous attitude that has fallen into bad repute.

The best examples of casuistry may be found in the fields of law and morals. Ethical casuistry reached its height during the scholastic period, hence casuistry and casuistical attitudes savor of scholasticism. All possible forms of conduct were neatly plotted and graphed, so to speak; each was labeled and given its proper place in the ascending and descending orders of goodness. Specific penalties for moral infractions were then provided. The ideal was to build a structure of moral knowledge indicating exactly where an individual stood with reference to his every act, even to the minutest details.

Moral casuistry has been largely outgrown; but it is much more difficult for the law to shake itself free from this heritage, chiefly because its procedure follows precedent. When courts regard it as their function merely to pass on the points of law involved in a case, regardless of novel circumstances or the underlying intent of the law, casuistry is the result. A lawyer who wins a case by means of a technical legal quibble over nonessentials displays casuistical ability.

**CASUS BELLI**, an event or occasion which furnishes a cause of war, or which may be used to justify war in a legal sense. Since the World War, an attempt has been made to divide wars into just and legal wars, and unjust and illegal wars. Legal causes are regarded as wars of self-defense, wars which break the League of Nations' covenants, and wars to preserve treaties of neutrality. Illegal causes of war are wars of aggression, a resort to war in violation of the League's obligation not to do so, and wars for territorial expansion.

**CAT** (*Felis domestica*). When the cat accepted domestication is unknown, as is its original ancestor. The present domestic form is believed by some zoologists to be a permanently mixed strain derived from the Egyptian wild cat (*Felis caffra*) and the common European wild cat (*Felis catus*). Specimens of the latter still extant in the forests of northern Europe, their flat heads, stubby tails and powerful bodies setting them definitely apart from household cats. As evidenced by ancient Egyptian mummies, the African wild cat had the longer tail and dark paw-pads which persist in the modern domestic cat. There is also evidence, based upon persistent characteristic markings, that a domesticated Chinese cat, itself tamed from a wild variety, contributes to the ancient ancestry of the modern animal.

The cat was greatly revered in Egypt, where it was a symbol of both sun and moon. It was mentioned in Sanskrit manuscript of 2000 B.C., was known to the Europeans of the Bronze Age, and in the Middle Ages was highly valued for its vermin-catching ability, heavy fines being imposed on cat-killers in Wales, Switzerland and Saxony. There are records of domestic breeds in South America before the white invasion; these must necessarily have been tamed from wild species. Although cats are of economic value,

as is attested by their enforced possession in some oriental cities, in post offices, warehouses and other places where vermin gather, they are prized to-day chiefly as pets. They are divided into long-haired and short-haired groups, the former being largely the so-called Persians and the Angoras. One theory regards long-haired cats as descended from the Pallas cat or manul of central Asia; they have, however, adopted the variety of color and coat seen in the short-haired breeds.

In show judging, long-hairs are classified by color: white, black, blue, brown, chinchilla; silver and orange tabby; smoke and tortoiseshell. Short-hairs add to these several tabby markings: black and white, tortoiseshell and white and such independent groups as the tailless Manx; the Abyssinian; the Siamese; the Indian, and the Mexican hairless, believed extinct. The European wild cat is a short-hair; the "Maine cat," of American development, a long-hair with wild-cat blood. The term "tabby" refers to coat markings, being derived from the same origin as taffeta, a watered silk.

The true Manx has a tail-like tuft of hairs but no tail bone; in Asia and in Russia there are occasional tailless cats as well as some with kink-tails. The Abyssinian, sometimes called the bunny cat, is believed by some authorities to be the variety worshipped and mummified by ancient Egyptians. Most curious of all is the Siamese, of which the delicate blue-eyed kittens are nearly white and the more hardy adults fawn or silver with black paws, faces and tails. The Siamese cat has a peculiar cry, as has the Indian cat, a tawny animal rarely seen outside India. The Mexican hairless, of which a pair existed as late as 1900, were found only in New Mexico.

Cats are clean house animals, requiring little care, but the well-fed cat is a far better mouser than the starved one. Some cats can be taught to leave birds alone and even to live amicably with tame mice and pigeons. Unless neglected, they are not more attached to places than to humans, but are so nervous that they must be quietly and carefully moved. Although independent, cats respond to and repay affection. They readily revert, in general, to the wild, but no pet cat should be abandoned. G. E. F.

**CATACOMBS**, the name given in general to subterranean tombs for the dead cut in the rock. They had their origin in the underground vaults of the church of San Sebastian in Rome, and are found in various regions of Italy, in Sicily and in Egypt. In Rome the catacombs were most used in the 3rd and 4th centuries, especially by the Christians and the Jews. However, they ceased to be used after 410, when Alaric pillaged Rome.

They usually consisted of long narrow galleries connected by passages, with horizontal niches for the bodies one above the other; at intervals there were small chambers with shafts admitting light and air from above; there were usually several stories. The niches were sealed by stone slabs or tiles, on which were painted or engraved inscriptions or decorations.



The walls of the galleries were often decorated with religious subjects of much interest in the development of Christian art. During the Roman persecution of the Christians the catacombs were used by the Christians as meeting places or refuges.

**CATALAN**, a ROMANCE language closely akin to PROVENÇAL spoken by 4,000,000 people in Catalonia and French Roussillon, with Barcelona and Perpignan as their respective centers. In the Middle Ages its literary form was Provençal, but since the 14th century it has been quite distinct. In spite of its contact with Spain, SPANISH has not deeply affected it. Like French, but unlike modern Spanish, it employs *en* "of it," etc., *hi* "there," *hom* "one" (as the indefinite pronoun), and *res* "nothing," as *jo me'n vaig* "I go away" (French *je m'en vais*), *no hi es* "he is not there" (cf. French *il n'y est pas*), *hom ha venut* "one has sold" (French *on a vendu*), *sense fer res* "without doing anything" (French *sans faire rien*).

H. F. M.

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**CATALEPSY**, a rigid, motionless state of the body, occurring spontaneously or in the hypnotic condition. The origin of it is not very clear. The cataleptic posture called cataplexy, which may result from fright, occurs in animals, lobsters, frogs and birds, and assumes the immobility of paralysis. The animal, when rigidly held, retains the immobile position, however unnatural, for quite a period. In the human it seems the result of suggestion of inability to move. It is not unlike the fixed position of ecstasy which may be induced by intense religious contemplation. It may go over to stupor, which may be of hysterical origin.

**CATALINA IRONWOOD** (*Lyonothamnus floribundus*), a rare and beautiful tree of the rose family, found native only on the Santa Barbara islands of southern California. It is a bushy tree, sometimes 55 ft. high, but often a shrub, with red-brown bark, scaling in strips, entire or much divided fern-like leaves, and white flowers borne in branched clusters. It is occasionally planted for ornament in California.

**CATALINA ISLAND.** See SANTA CATALINA.

**CATALONIA**, an autonomous region within the Spanish State, in the northeast of the Iberian Peninsula, bounded on the north by France, on the west by Aragon, on the south by Valencia, and on the east and southeast by the Mediterranean, occupying an area of 12,430 square miles. It has been related geographically and politically with BARCELONA, which province was formed in 1833 of districts belonging to Catalonia.

Under Roman rule Catalonia was embraced in Hispania Tarraconensis. It fell to the Alans and Goths late in the 5th century, and to the Moors in 712. Charlemagne evicted the Moors in 788, and established rule by Frankish counts. These rulers soon declared their independence of French authority. In 1151 Catalonia was united to Aragon by the marriage of Earl Ramon Berenguer to Princess

Petronilla. The wealth of the country in gold and other resources, and of Barcelona, its capital, in trade, joined to make the frontier state a tempting prize in the eyes of the peninsula rulers. Philip IV in 1640 attempted to gain control of the principality but was prevented by the military intervention of Louis XIII of France. Catalonia came under Spanish rule in 1659, but from 1694-97 and again from 1808-13 was occupied by the French. It has long been the scene of autonomist agitation. In Jan. 1927 a Catalan separatist named Marcia attempted to seize control of the four provinces comprising modern Catalonia: Gerona, Lerida, Barcelona and Tarragona. Revolutionary sentiment in Catalonia, notably in Barcelona, was one of the main factors which caused the abdication of King Alfonso on Apr. 14, 1931. The Spanish Cortes granted autonomy to Catalonia in 1932.

**CATALPA**, a genus of trees of the bignonia family, comprising about 10 species found in North America, the West Indies and China. The common catalpa or Indian-bean (*C. bignonioides*) of the southeastern United States, often planted for shade, is a stately tree with silver-gray bark, broadly heart-shaped leaves, and showy clusters of white, much striped and spotted flowers. The larger and more hardy western catalpa (*C. speciosa*), cultivated for ornament and for timber, grows from Indiana to Missouri, southward to Tennessee and Arkansas, and is naturalized elsewhere through cultivation. It has thicker bark and less conspicuously spotted flowers.

**CATALYSIS**, the name given to the phenomenon occurring in chemistry when the speed of a chemical reaction is materially altered by the presence of some additional substance, called a catalyst, which remains unaffected in the end. One of the best known examples is that of the inversion of sugar in a watery solution: if pure sugar be dissolved in pure water, the speed of the reaction is small, while the presence of even a slight trace of acid accelerates the reaction to such an extent that it is practically completed within a reasonable time. From the chemical equation of the decomposition taking place, it is clear that the acid is not directly involved, and although no final explanation of catalysis has as yet been given, it is thought that the rôle of the acid is merely to produce a very unstable intermediate compound whose speed of formation as well as of decomposition is so great as to render the time of its actual existence too short to be detected.

Catalysis may take place in various forms. Sometimes one of the products of the reaction itself acts as a catalyst, as in the hydrolysis of organic esters into their acids and alcohols; here the acid formed helps to speed up the decomposition, and the process is spoken of as autocatalysis. In other cases, it may be the solvent which influences the reaction; while in a combination taking place between gases, mere contact with the catalyst will suffice, and it is advantageous to have the surface area of contact increased as much as possible by dispersing the catalyst as a fine powder over spongy or fibrous bases, or by using it in colloidal

solutions. In still other processes the action of light may be catalytic.

Since a catalyst is not ultimately affected by the reaction, it should be able to continue its action indefinitely. Often, however, its efficiency may be materially reduced either by the products themselves becoming overheated through the heat developed or by the combination of the catalyst itself with some slight impurities in the materials. Thus metallic catalysts in gas reactions are often "poisoned" quickly if minute quantities of sulphur are present in the reagents; but on the other hand, the action of a catalyst may be "promoted" by other substances, themselves without catalytic power, as is the case with the influence of oxides of iron upon these same metallic catalysts in gas reactions. Catalysts which decrease the speed of reactions are often called *inhibitors*; their actual function may sometimes be no more than the killing of an unsuspected catalyst present in minute quantities.

Among the most important catalysts in industrial processes are finely powdered metals or metallic oxides. Thus, very pure, powdered IRON obtained by the reduction of iron oxides in a current of hydrogen is used in the Haber process of making synthetic ammonia; metallic nickel in the hydrogenation of drying oils into solid fats; finely divided vanadium oxides, platinum or palladium, preferably spread out over asbestos or pumice stone, in the synthesis of sulphur trioxide from sulphur dioxide and oxygen in the manufacture of sulphuric acid; metallic sodium in the polymerization of isoprene into synthetic rubber. In the synthetic production of acetic acid, mercuric sulphate and the oxides of iron, uranium and vanadium play a rôle, as they do in many other organic reactions.

**CATAMARAN.** See BOAT.

**CATANIA**, the leading seaport of Sicily, situated near Mt. ETNA on the east coast. A settlement was established here in 729 B.C., which was taken by the Romans in 263 B.C. Catania has been overwhelmed by volcanic eruption, devastated by earthquake and sacked by barbarians. New cities have been built repeatedly over the old; but it remains famous for its wealth of Roman remains, indicating the importance of the colony. It possesses one of the largest Roman amphitheatres in existence, also many public baths, and tombs. The University of Catania was founded about 1445. VINCENZO BELLINI, the composer, was born in the city. The countryside produces lemons, oranges and olives in quantity, and the city is a commercial center for the important Sicilian sulphur mines; it also has dye works, and exports pumice stone, asphalt, nuts, cereals and wine. Pop. 1931, 227,765.

**CATANZARO**, a city of southern Italy, capital of the province of the same name in the mountainous part of central Calabria. It is beautifully situated 10 mi. from the little seaport Catanzaro Marina, and 2 mi. from the railroad station Catanzaro Sala. The city is the seat of a bishop, a court of appeals and other official bodies, and has a cathedral and pro-

vincial museum. The silk industry is important. Catanzaro has suffered frequently from earthquakes. Pop. 1931, 41,888.

**CATAPHORESIS.** See ELECTROPHORESIS.

**CATARACT.** See EYE, AFFECTIONS OF.

**CATAWBA**, formerly an important Siouan tribe living, at the time of their discovery, in the Carolinas where they were second in importance to the Cherokee. The surviving members now live with the Cherokee on a North Carolina reservation or are scattered among white communities. They were continually at war with the Iroquois groups to the north and with the tribes of the Ohio valley. They were sedentary agriculturists, good potters and basket-makers, and excellent hunters.

**CATBIRD** (*Dumetella carolinensis*), a common American song bird closely allied to the mockingbird. It is about 9 in. long, with dull slaty gray plumage, black crown and tail, and reddish-brown underparts. Frequenting orchards, gardens, thickets and bushy swamps, the catbird breeds from British Columbia to Nova Scotia and southward to New Mexico and Florida, and winters southward to Cuba and Panama. Although feeding to a large extent upon fruits and berries, sometimes damaging crops, it destroys large numbers of injurious insects. Its call notes are harsh and ugly, resembling the mewing of a cat, but its song is very melodious and often imitative of the notes of many other birds. The catbird builds a large nest of twigs and rootlets usually in dense shrubbery, laying three to five bluish-green eggs. It commonly rears two broods of young in a season.

**CATBOAT.** See BOAT.

**CATCHFLY**, the name given to various plants of the PINK family, some of which secrete on their stems or flowering branches sticky substances which entrap small insects. Examples among garden plants are the sweet-william catchfly (*Silene Armeria*), with a portion of each joint of the stem glutinous, and the German catchfly (*Lychnis Viscaria*), which has sticky patches beneath the flower clusters. The sleepy catchfly (*Silene antirrhina*), which grows wild across North America, has black sticky bands encircling the stem.

**CATCHMENT AREAS**, irregularly shaped patches of the earth's surface from which the rainfall flows to one outlet on or below the ground surface. They are also known as "watersheds." The extent and character of such areas determine the flow of streams, the levels of ground-water, the quantity of water available for storage in impounding RESERVOIRS, and the burden of flood flow for which flood prevention and drainage works must be designed.

E. E. W.

**CATEAU CAMBRÉSIS, TREATY OF**, the treaty concluded by HENRY II of France and PHILIP II of Spain and England in 1559, by which the two powers mutually restored their conquests in Italy and The Netherlands, with some exceptions. Among the latter was the retention by France of Calais, Boulogne and the Three Bishoprics. The real motive for

the cessation of the war between Henry and Philip was the latter's desire to husband his strength against Protestantism which was gaining in the north and east of Europe by making peace with the other great Catholic power of the Continent, namely France. A double marriage was to have accompanied the ratification of the treaty, but the death of Henry II by accident in a tourney put an end to both Philip's plan of alliance and peace for the French nation, thenceforth torn by civil and religious wars for 30 years.

**CATECHISM**, a statement of beliefs in the form of question and answer. In the early Church, prospective converts were so taught the Christian faith and, in the Greek language, were called *catechumens*. During the Reformation because of the need for popular instruction in the principles of Christian faith, numerous printed catechisms came into use. In 1520-29 Martin Luther wrote two shorter and longer catechisms. The Geneva Catechism, dated 1536, was written by John Calvin and was obligatory in the schools of that city. The original Anglican catechism dates from 1549 but was later enlarged. A famous catechism was issued by the Protestant synod of Heidelberg in 1563. The Westminster Assembly of Divines, meeting in 1647, produced a Longer and Shorter Catechism, definitive of Presbyterianism. In 1568 the Roman Catholic or Tridentine Catechism was issued and followed the statement of doctrine by the Council of Trent. In many churches, it is customary to expect children awaiting confirmation or acceptance of the privileges of the Church to commit a catechism to memory.

**CATECHUMEN** (Greek, *katechoumenos*, one instructed), a term applied to those whom the early Christian Church subjected to a period of instruction preparatory to baptism, a practice made necessary by danger of betrayal when Christianity was still an outlaw religion. Some elements of the catechumenate as it later developed are found at the end of the 1st century; at the end of the 2nd century it was organized and functioning in various places. It flourished in its full form during the 3rd and 4th centuries.

Catechumens were divided into several classes. During the first stage, as *audientes* or hearers, they received elementary instruction only and were dismissed after a discreetly worded sermon. When the elders were satisfied of their seriousness, the candidates were admitted to the full rank of catechumen by rites which differed according to time and place. They remained longer than the hearers, but were dismissed before that part of the service which is known as the Mass of the Faithful. During a final stage as *competentes*, though some authorities do not make this distinction, they were given more detailed information and received on occasions known as *scrutinies* specific revelations of doctrine such as the Lord's Prayer and the Creed.

The total period allowed for the catechumenate varied from the 40 days of Lent to two years, accord-

ing to time and circumstance. It sometimes happened that the candidate, as in the case of Constantine, deliberately waited until death seemed near for the last initiation. Several of the saints, indeed, postponed baptism, St. Martin of Tours for 10 years and St. Augustine until he reached the age of 33. As the development of the doctrine of grace encouraged the practice of infant baptism, the catechumenate tended to disappear. The process was hastened, however, if not primarily determined, by two secular factors: the passing of the need of secrecy and the impossibility of subjecting masses of new Christians to a long period of instruction.

**CATEGORY**, a most general form of being; a necessary function of the understanding; a mode of classification. The term originated with Aristotle who used it in the first sense. The second conception is Kantian, and the third meaning indicates the popular use of the term.

ARISTOTLE recognized ten general modes of being which he designated as the categories. Among them are such general concepts as quantity, quality, relation and position. Any form of being, i.e., anything which exists, must be thought of in terms of one or more of the famous ten categories, otherwise the Aristotelian scheme is not exhaustive.

In the Kantian sense the term category means an activity of the understanding. When an object is presented to the senses it is immediately clothed by the understanding in its own forms, so that the object can be known only by means of the categories which the understanding supplies. IMMANUEL KANT recognized twelve of these categories, which he divided into four main groups with three in each division. Of these, substance and causality were the most important and gave him the greatest difficulty. The Aristotelian category is a form of being; the Kantian a form of knowledge.

In its popular meaning a category is a division of classification. It is often stated, for example, that two objects do not even belong in the same category, meaning that they are so different that they cannot be classed together.

**CATENARY**, the curve formed by a chain (Latin, *catena*) hanging freely from two of its points, the points not being in the same vertical line and the chain being homogeneous. Its equation is

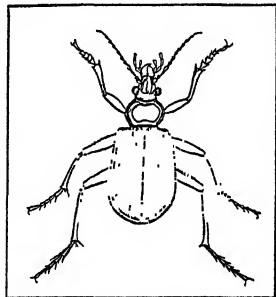
$$y = \frac{1}{2}a \left( e^{\frac{x}{a}} + e^{-\frac{x}{a}} \right).$$

It is the curve of the cables of a suspension bridge before the weights are placed upon them. Its discovery is due to Leibniz (1646-1716). See CURVES.

**CATERPILLAR**, properly the larva of any lepidopterous insect. By extension various other larvæ of similar form. Some are naked or nearly so; others clothed with hair. Usually they are cylindrical with three pairs of true, or thoracic, legs and two to five pairs of "prolegs" variously placed on the abdomen. The latter are shed when the larvæ pupate. The majority of caterpillars spin silken cocoons. Others form

their cocoons of their hair fastened with webs of silk. Still others form naked chrysalids. These may be fastened to some object above ground or may be buried in the earth.

**CATERPILLAR-HUNTER**, an American ground beetle (*Calosoma scrutator*), one of the largest and most beautiful of the Carabidæ. It is about an inch



CATERPILLAR-HUNTER

and a quarter long, and has reddish margined green or violet wing covers. The rest of its body is marked with gold, copper, green or blue. The name is also sometimes applied to its somewhat smaller relative *C. calidum*. The latter is more properly called the fiery hunter because of the rows of reddish-copper pits on its wing covers. Both species climb trees

and shrubs in search of caterpillars upon which they feed.

**CATERPILLAR TRACTOR.** See TRACTORS; CATERPILLAR TREAD.

**CATERPILLAR TREAD**, a device for distributing the traction and the load of a TRACTOR over a larger area than is possible with wheels. A long, continuous metal belt, or tread, runs over the driven wheel and front wheel—and sometimes over several “idler” wheels as well. This belt carries on its outside—the side coming into contact with the ground—“cleats” or depressions which give it tractive efficiency. The inside surface of the belt is a smooth track on which the idle wheels can run, but is provided with teeth which the driving wheels engage. As these driving wheels are turned by the power of the engine, the belt continuously comes in contact with the ground; being, in effect, “laid down” in front of the foremost wheels. The distributed weight on the belt is as low as five pounds per square inch, which permits tractors so equipped to work easily on very soft or “boggy” ground. Their characteristics give them a high utility in farm work, in lumbering and logging, and in clearing away snow. See also TANKS.

**CATFISHES**, a numerous order (*Nematognathi*) of bony fishes, so named because of the whisker-like barbels around the mouth. There are upwards of 1,200 species found chiefly in fresh waters in warm regions; only a few inhabit the sea. They are readily distinguished by their scaleless bodies, which are either smooth or armored with bony plates; by barbels on both jaws, and by a stout spine in the dorsal fin and in each pectoral fin. This spine, which can be made rigid by a rotary motion in its socket joint, is capable of inflicting a severe wound. Catfishes range in length from 2 in. to 6 ft., are carnivorous bottom feeders, and many are highly esteemed for food. Some 30 species occur in the United States, a few of which are marine. Of these the best known are the common bullhead (*Ameiurus nebulosus*), widely distributed in

quiet waters; the great blue catfish (*Ictalurus furcatus*), sometimes 5 ft. long and weighing 150 lbs., abundant in large rivers in the South, and the channel or spotted catfish (*I. punctatus*), about 2 ft. long and weighing 25 lbs., common in large streams from the Great Lakes southward. In 1930 the total catch of catfishes in the United States, taken chiefly in the Mississippi Valley and the Gulf States and amounting to 16,347,000 lbs., was valued at \$1,190,000.

**CATGUT**, a term applied to the thin cord made from the intestines of sheep, or occasionally from the intestines of the horse or mule. The term is believed to have come from the old English term “kitgut,” the term “kit” being applied to a fiddle. Fiddle strings are made from this material. The best strings for musical instruments are made in Italy, lean or poorly fed animals furnishing the toughest and strongest material.

Catgut is used more especially, however, for suturing surgical incisions or tears in the tissues. It is absorbed and disappears as the tissues heal. In preparing catgut, the intestine is cleaned, freed from fat, soaked in water, and scraped with a blunt knife. The material is then treated with alkali and with antiseptic and twisted to form. Modifications include chromic catgut, which is sterilized and treated with chromium trioxid; formalin catgut, which is impregnated with formaldehyde by boiling in an alcohol-formaldehyde solution. There are also special forms treated with iodine, with potassium iodide and with silver salts. Special claims are made for various preparations according to their tensile strength, their sterility and their flexibility for use in surgery. M. F.

**CATHA** (*Catha edulis*), called also Khat or Cafta, an evergreen shrub of the staff-tree family, native to Arabia and Africa and cultivated in warm countries. It grows about 10 ft. high, bearing oblong-toothed leaves and small white flowers. Since ancient times a beverage possessing qualities similar to those of tea and coffee has been prepared from the twigs and leaves, which are an article of commerce in Arabian markets.

**CATHARS** (Cathari or Catharists, meaning the pure), an heretical sect having many branches, which was widely spread during the Middle Ages. The dualistic doctrines of the Cathars, derived from Oriental sources, resembled closely those of the Gnostics (see Gnosticism) and Manichaeans (see Manichaeism). They held that the universe is governed by two forces: the principle of good, which presides over the spiritual world, and that of evil, identified with Jehovah, which created the material world. The elders of the sect, who led an extremely austere life, were known as the Perfect, having received the sacrament called the *Consolamentum*. On a lower plane were the uninitiated, the Believers, who obeyed the Perfect implicitly. Private property, war, falsehood, and the eating of animal food were all considered sinful by the Cathars. The sect disappeared in the 14th century. The ALBIGENSES formed the most numerous branch of Catharism.

**CATHARTICS**, drugs which promote evacuation of the bowels. Cathartics should not, as a rule, be taken when there is abdominal pain. Pain in the abdomen may mean an inflammation of the bowel; and cathartics, by stirring up peristalsis, may aggravate the inflammation and the pain, and cause dissemination of infection throughout the abdominal cavity, as occurs only too often when physics are used in acute appendicitis. The same restraint should be applied in the treatment of intestinal colic and obstruction. For the removal of impacted feces, enemas should be preferred. In case of mechanical obstruction by kinks or twists, the increased peristalsis produced by purgatives will force intestinal contents into the stomach, increasing the foul vomiting; while the driving of the intestinal contents against the obstruction aggravates the injury existing at that point, leading to dilatation, sloughing, hemorrhage, and even perforation. In case of such obstruction, surgery, though it has some danger, is safer than purgative.

*Laxatives* are the mildest form of cathartic. When there is a tendency to colonic spasm, called also spastic colitis, an indigestible oil, like liquid petrolatum, or mineral oil, may prevent such spasm by keeping the fecal matter soft and rendering it less irritating. It is so mild an agent that it may be used in painful forms of constipation without likelihood of producing harm, though it is sometimes too mild to produce results.

Another agent characterized as laxative is sulphur, which can do no more than produce soft mushy stools. It is useful for persons troubled with hemorrhoids, or piles, who are notoriously intolerant of strong physics.

Agar, almost indigestible to our digestive juices as well as to microorganisms, passes through the bowel, adding bulk to the feces and softening them by retaining moisture. The cellulose of fruits and vegetables as well as bran largely act in this manner. These cellulose laxatives are preferable, unless they produce flatulence, due to excessive bacterial decomposition of cellulose which results in the formation of gases. It is in such cases that agar may find a special place.

The *purgatives* constitute a class of stronger cathartics than the laxatives. They cause profuse bowel evacuation, but do not produce gastro-intestinal inflammation. Castor oil differs from mineral oil in that some of it is digested, with liberation of an irritant fatty acid that causes its own expulsion. The undigested excess of oil has the same soothing and softening effect as liquid petrolatum. It is because of this combination of soothing and softening effect, with a thorough evacuant action which cannot become excessive, that castor oil still plays an important rôle in medicine, especially of childhood, in spite of its reputed nasty taste, which, however, modern pharmacy has succeeded in disguising to a considerable extent. When, in the treatment of diarrhea, one wishes to reinforce nature and sweep the poisonous contents out of the bowel as promptly as possible, castor oil is the purgative *par excellence*.

The saline purgatives, epsom salts (magnesium sul-

phate), Glauber's salt (sodium sulphate), Rochelle salt (sodium and potassium tartrate) and sodium phosphate, all act by retaining fluid in the large bowel, this giving rise to liquid bowel movements. When they act well, as they generally do in people who are up and about, they produce their effect within a few hours. In bed patients they are frequently disappointing because they do not stimulate peristalsis to any extent. Because of the fluidity of the evacuation, they are often more efficient in getting the colonic contents past kinks and other narrowings in the large bowel than does mineral oil, which merely softens them. Being devoid of irritative action, they may be used in spastic conditions of the bowel. They have, however, the disadvantage of sweeping nutritive material out of the bowel, which makes them liable to aggravate malnutrition. They are sometimes employed to reduce weight in obesity, a use which is rather objectionable; for it is much more rational to lessen the intake of food.

CALOMEL (mild mercurous chloride) is tasteless and non-irritative in the stomach, so that it is usually retained by patients who vomit. Its action begins as it reaches the alkaline juices of the upper bowel. By sweeping the contents of the small intestine into the colon it lessens the reabsorption of bile, and this is responsible for the bile-colored stools it produces and for its reputation that it acts upon the liver. Calomel is not a reliable cathartic. While it acts with certainty on the upper bowel, it seems to exhaust its action in many cases by the time it reaches the lower bowel. Hence it is usually associated with a cathartic that may be relied upon to complete the action, such as the citrate of magnesium. This is all the more necessary because the longer the calomel remains in the lower intestine, the more mercury becomes absorbed into the system and the greater is the liability to the salivation of mild mercurial poisoning. As some mercury is absorbed even when we get prompt evacuation, calomel is not suitable for continuous or frequent use.

CASCARA, SENNA, RHUBARB and ALOË form a group of purgatives characterized by special effect upon peristalsis. The mildest of them—cascara—or small doses of the stronger one, are noteworthy for producing natural formed stools and for being less liable to leave constipation as an after-effect, as most other cathartics tend to do. Senna is the one of these most easily made pleasant, so that it may be administered to children by their mothers wittingly or unwittingly; for the popular compound licorice powder and "syrup of figs" and many other so-called infant correctives rely upon senna. Its general use is to be condemned. It is bad enough for a senile individual, too feeble to exercise, to become a slave to physic; it is unpardonable in youth. When, however, conditions exist that render habitual catharsis necessary, as in the aged, aloë is most likely to be the best agent to use; for it lends itself admirably to pill administration. When such pills become necessary, their use on the evening of any day on which the bowels have not moved is generally sufficient.



As *drastic cathartics* are classed those agents that have a sharp purgative action and which in overdose may act as irritant poisons. Among them may be mentioned croton oil, colocynth and podophyllum. Their use is very properly becoming more and more restricted. For a good physic is not, as some layman seem to imagine, a strong one; but the very mildest one that will do the work. Colocynth and podophyllum are nowadays used chiefly to increase the reliability of aloë pills, most especially because aloë is deficient in action upon the upper bowel. Podophyllum, which, owing to its elective action upon the upper bowel, has been called the "vegetable calomel," is probably especially useful for this purpose. B. F.

**CATHER, WILLA SIBERT** (1876- ), American novelist, was born at Winchester, Va., Dec. 7, 1876. After a childhood spent on a Nebraska ranch, she was graduated from the University of Nebraska in 1895. Later she taught in high schools, did newspaper work, traveled and in New York City was a magazine editor for several years. Her first work to attract attention was *O Pioneers*, published in 1913. Among the novels that followed were *My Antonia*, *The Song of the Lark*, *One of Ours*, a story of a soldier home from the World War which won the Pulitzer Prize in 1922, *A Lost Lady*, 1925, *The Professor's House*, *Death Comes for the Archbishop*, 1927, and *Shadows on the Rock*, 1931. She also wrote a book of verse, *April Twilights*, 1903, and numerous short stories, including the collections, *Youth and the Bright Medusa*, 1920, and *Obscure Destinies*, 1932. The Nebraska of Miss Cather's youth has given locale, character and inspiration for much of her work. Her method is realistic, her outlook broad, and her themes are given wide implications. She is distinctly American in all her writings.

**CATHERINE, ST.** Born Catherine Fieschi at Genoa, 1447, she died a famous nun at Genoa, Sept. 14, 1510. Her biographies are chiefly based on *Memoirs* drawn up by her confessor and friend. Her father was Jacopo Fieschi, Viceroy of Naples, and two Popes, Innocent IV and Adrian V, were of the Fieschi family. At 16 she was married by her parents to a young Genoese nobleman, Giuliano Adorno, but the alliance proved to be an unhappy one, due to his violence, faithlessness and spendthrift ways. At 26 she became subject to religious ecstasies, and her revelations can be read in her *Dialogues of the Soul and Body*, and in her *Treatise on Purgatory*. She converted her husband before he died in 1497, and spent her days with the sick and plague-stricken in the great Hospital of Genoa, of which she became manager and treasurer. She was beatified by Clement V in 1675 and canonized by Clement XII in 1737.

**CATHERINE II** (1729-96), was born at Stettin, May 1, 1729, and began life as the Princess Sophia-Augusta of Anhalt-Zerbst, a minor German principality. She had the good fortune to be recommended by Frederick the Great as a suitable consort for the Grand Duke Paul of Holstein, grandson of Peter the Great, who had been brought to Russia in

1742 as prospective heir to the Empress Elizabeth. Catherine's education had been rough but thorough, and she was a good judge of men. Accustomed to poverty as the daughter of a minor prince of slender means, she arrived at Leningrad in February, 1744, with a trousseau of three gowns, and in August, 1745, she was married to the Grand Duke. In 1754, she bore the Grand Duke a son, Paul (subsequently the father of Alexander I and Nicholas I), though there are reasons for questioning the Grand Duke's paternity; there was never any sympathy between the princely pair. In contrast with the keen-minded Catherine, Peter was a dullard, given to heavy drinking, interested only in military drill and in women less gifted than his wife and a rabid admirer of Frederick the Great. Catherine employed her isolation in omnivorous reading and in mastering Russian. Her tact and personality won her numerous loyal friends, whose numbers were augmented as soon as Peter's accession permitted him to threaten his wife with divorce and to apply such ill-judged reforms as his capricious fancy dictated. The summer of 1762 Catherine passed at Peterhof apart from her husband, who was then living at Oranienbaum, another suburb of Leningrad. The culmination of a military conspiracy in Catherine's interest was hastened by threats of impending exposure. Therefore, on June 28, her supporters brought her to the capital and presented her to the guard regiments, who received her enthusiastically and marched on Oranienbaum under her standard. Thus threatened, Peter abdicated and was sent under surveillance to an estate at Ropsha, where he perished in a drunken brawl with the officers supposed to be guarding him.

Even after arriving at the goal of her desire, Catherine's position was threatened by the conflicting ambitions of her favorite partisans, by official efforts to limit her authority and by clerical attempts to nullify the reforms of Peter I applying to ecclesiastical property and income. She won the allegiance of the nobility by her close devotion to Russian interests and her oft-expressed confidence in the great destiny of the nation. Her political views were at first notably liberal, being largely inspired by her study of Montesquieu and the Encyclopedists. Though she possessed at the outset too little practical experience to realize that these ideals were hardly applicable to 18th century Russia, she rapidly acquired discretion with years and was finally converted to conservatism by the events of the French Revolution. Her aims in foreign policy followed the same ideals of westward expansion into Europe which had animated Peter the Great. An opportunity to realize them in a marked degree presented itself in 1763 when the Polish throne became vacant. By encouraging a state of anarchy, Catherine, in 1772, secured the agreement of Prussia and Austria to the first partition of Poland, which brought the whole of eastern Lithuania under Russian sway. Meanwhile, her generals and naval commanders operating against the Turks and Tatars were winning the Crimea, the steppes between Dniester and

Bug and free shipping rights on the Black Sea. In 1789-90, she repulsed a Swedish attack, and, in 1792, once more in connivance with Prussia and Austria, secured a further parcellation of Poland, the remaining third of which was swallowed up by the avid powers after the defeat of Kosciuszko three years later.

Catherine's early impulses toward political reform are best expressed in her *Nakaz* (Instructions) based on Montesquieu and Beccaria which she desired to use as a basis for debate by a reformatory National Assembly made up of representatives of nobility, clergy, burghers, free peasants and non-Russian elements. This rudimentary parliament met in 1767, but soon proved so inefficient as to be abandoned by its sponsor. Though Catherine herself recognized well enough that the chief evil menacing the Russia of her day lay in serfdom and its concomitant abuses, she could not seriously think of abolishing it, since she had come to the throne solely by the support of the gentry whose very living depended on serf labor. During her reign, the situation of the serfs actually grew worse, while their numbers were constantly increased by her donations of hitherto free peasants to her favorites. The abuses of serfdom culminated in 1773 in the peasant revolt on the Volga, headed by Pugachov, which extended even to Moscow in the two years of its duration. The Turkish wars and Pugachov's rebellion convinced Catherine of the necessity for administrative reforms; her organization of the empire into provinces and districts and the official mechanism established by her for their control lasted practically unchanged till the reign of Alexander II. Her enthusiasm for education bore scanty fruits apart from her interest in the Academy of Sciences and the establishment of a school for daughters of the aristocracy at the Smolny Monastery in Leningrad. In all respects, Catherine's initiative outran her execution; she lacked the persistence essential for basic and thorough reform.

Catherine's personal life and character have always presented a theme of peculiar interest. A woman of well-developed physical nature, she was cut off from its normal expression by a loveless marriage. She no more than followed the custom of her predecessors in entering upon a series of liaisons with various favorites of diverse character and ability, yet these relationships were numerically more important than the divagations of previous Russian sovereigns, and played a genuine rôle in the political destiny of Catherine's reign. Of her favorites, the most notable were Stanislaw Poniatowski, the last king of Poland, and Potyomkin, the conqueror of the Turks. Catherine's intellectual energy kept pace with her physical vitality. She corresponded untiringly with foreign literary personages like Voltaire; she purchased not only his library but also that of Diderot, which she bought before the latter philosopher's death, leaving him as its curator. Her interests in literature were primarily political; she cared little for the French classics and was bored by Beaumarchais. During her period of liberalism

she encouraged and contributed to one satirical journal, and subsequently wrote 14 plays, nine librettos and seven dramatized proverbs. Her own devotion to intellectual pursuits inspired an unparalleled forward movement in Russian literature, in which her reign brought to light such pioneer talents as the dramatists Sumarokov and Fonvizin, the poet Derzhavin and the journalist Novikov, all of whom, though long since outmoded, are worthy precursors of Russian literary genius of the 19th century.

Catherine died on Nov. 17, 1796. Her reign forms to some extent an appendage to that of Peter the Great in that she rounded out his territorial conquests, continued in a calmer atmosphere the rapprochement with western Europe which he had accelerated, strengthened the central administration without organizing local government and retained serfdom intact. Catherine thus broadened the chasm between the ruling classes and the peasantry, and made no contribution toward solving the major social problems of the empire. Though personally the ablest monarch on the Russian throne in the history of the Romanov dynasty, her alien origin and dynastic illegitimacy prevented the fruition of her liberal projects during the period of her life when she was most inclined to put them into practice.

S. H. C.

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**CATHERINE DE' MEDICI** (1519-89), Queen of Henry II of France and regent during the minority of Charles IX, was born at Florence, Italy, in 1519. She was the daughter of LORENZO DE' MEDICI, Duke of Urbino; in 1533 was married to the Duke of Orleans who became Henry II, 1547-59. She was the mother of Francis II, 1559-60, Charles IX, 1560-74, and of Henry III, 1574-89. Catherine served as actual regent for Charles IX from 1560-63 and from the time of the accession of Francis II in 1559 until her death was the power behind the throne. She conspired alternately with the Huguenots and with the Catholic party of the Guises in an attempt to keep either party from gaining too much power. She played a considerable rôle in the beginning of the politico-religious wars which ravaged France with some intermissions from 1562 until 1598. In 1572 she entered into an intrigue with the Guises to kill the leaders of the Huguenots, resulting in the Massacre of St. Bartholomew, Aug. 24, 1572. Catherine died without friends at the castle of Blois, France, Jan. 5, 1589.

**CATHERINE OF ARAGON** (1485-1536), Queen of England, was born Dec. 15, 1485, youngest daughter of Ferdinand and Isabella of Spain. She left for England in 1501 to marry Arthur, eldest son of Henry VII, and when Arthur died she was betrothed in 1503 to the king's second son, Henry. Quarrels between the Spanish and British monarchs over her marriage portion, as well as a series of political maneuvers in which Catherine was merely a pawn delayed the wed-

ding until 1509, the year her husband mounted the throne as Henry VIII. Despite his uncertain temper and fickle character, Catherine remained Henry's queen for twenty years. The king was desirous of a male heir, and his infatuation for ANNE BOLEYN, one of the queen's maids of honor, added personal desire to questions of state. He, therefore, determined to rid himself of Catherine. When the Pope refused to sanction a divorce, Henry broke with him and secured an annulment from a pliant English clergy. Catherine was abandoned in 1531, and two years later Henry married Anne Boleyn. The former queen was separated from her daughter Princess Mary and was sent to Buckden in Huntingdonshire, where she was virtually a prisoner. A tragic figure, Catherine spent her last years in pious study and in defiant claims to the throne for Mary. She died at Kimbolton, Huntingdonshire, Jan. 8, 1536.

**CATHERINE OF SIENA, ST.** (1347-80), Italian mystic, author and ecclesiastical reformer, was born in Siena, Mar. 25, 1347. She surrendered herself to a religious life from a very early age and entered the Dominican Order, and there she soon received those mystic visions and the *stigmata* that have rendered her name famous. Although in poor health, St. Catherine worked with astonishing energy to end the historic schism in the Roman Church; but she is best known to-day for her literary endeavors, especially for that remarkable mystic work entitled *The Book of Divine Doctrine*, purporting to be a dialogue between a soul and the Lord. St. Catherine died at Rome, Apr. 29, 1380, and her feast day is celebrated on Apr. 30.

**CATHODE**, a term used to designate the electrode by which electricity leaves a solution in an electrolytic cell, being the opposite of ANODE. It is the negative electrode and when a solution is ionized in ELECTROLYSIS, the positive ions move toward the cathode. Thus, in electroplating, the material to be plated serves as the cathode.

In an electronic tube (*see* TUBE, ELECTRONIC), the cathode is that part which emits ELECTRONS when heated. It may be any type of metal FILAMENT directly heated by an electric current, or it may be a sheath around a heater filament. In the latter case, the potential of the cathode is not limited to the potentials of the filament.

**CATHODE RAYS**, streams of high-velocity ELECTRONS. They may be produced by passing an electrical discharge through a partially evacuated chamber or by heating a FILAMENT in a vacuum. Their velocities range from a few hundred to many thousand miles per second, depending on the voltage of the battery used in their acceleration.

Cathode rays produce X-RAYS when suddenly stopped by solid bodies. They produce FLUORESCENCE on luminescent screens, blacken photographic plates and ionize gases through which they are passing by breaking them up into charged particles. When traveling through a rarefied gas, they may be detected as a faint streak of light. Sharp "shadows" are cast

by solid objects in the path of these rays, showing that they travel in straight lines. Since they leave the cathode, or emitting surface, at right angles, they may be focused by a concave surface and used to melt small amounts of metal or to rotate a small paddle wheel, which shows that they possess a considerable amount of energy. After passing through a thin aluminum window in a vacuum tube, cathode rays will travel in the outside air for a distance as great as one foot.

These rays may be easily deflected by magnetic and electric fields, this principle being used in the cathode ray OSCILLOGRAPH. *See also* ELECTRONICS. J. B. H.

**CATHOLIC BENEVOLENT LEGION**, a fraternal, beneficiary society of Roman Catholic laymen founded in Brooklyn, N.Y., in 1881. Its object is not only to facilitate life insurance from its members, within certain fixed circuits, but also to provide opportunities for social intercourse and intellectual improvement. Men between the ages of 18 and 55 are eligible. The amount of insurance may not exceed \$5,000. The whole organization, comprising branches in many states, is under the guidance of a Supreme Council to which all final appeals are addressed. A group may be formed in any congregation or parish. In 1925 the society was reorganized and greatly strengthened financially.

**CATHOLIC EMANCIPATION** refers to the passage in 1829 of the Roman Catholic Relief Bill in England. It was passed by a large majority in Parliament, although signed reluctantly by the King. Its passage removed certain political, social and religious disabilities suffered by Roman Catholics, enabling them to worship according to the dictates of their conscience and educate their children unhindered by restrictions. The act of Parliament was largely the result of a steadily growing spirit of toleration and the earnest work of the Catholic Committee, later known as the Cisalpine Club, under the pioneering leadership of Lord Robert Edward Petre and Lord Stourton. It was also facilitated indirectly by the FRENCH REVOLUTION, which drove about 8,000 Catholic clergy to England where they were hospitably received.

**CATHOLIC KNIGHTS OF AMERICA**, a Catholic fraternal order chartered under the laws of Kentucky and organized in Nashville, Tenn., in 1877. The first session of the Supreme Council was held in 1878, and branches were soon established throughout the United States. Financially it has developed steadily until it holds high rank among the life-insurance fraternal organizations of this country. In 1930 the Catholic Knights of America counted 19,000 members. Its headquarters are at St. Louis, Mo.

**CATHOLIC UNIVERSITY OF AMERICA**, an institution at Washington, D.C., which was incorporated in 1887, and chartered in 1889 by Pope Leo XIII. It was opened as a School of Theology but later added schools of Law, Philosophy, Letters and Sciences, and Canon Law. The university is controlled by the Hierarchy of the Catholic Church of

the United States. Until 1908 when the collegiate department was added, the university was for graduate students only, and graduate work is still emphasized in the majority of departments. Women are admitted only to the Law and Graduate schools. The first endowment to the university was a gift of \$300,000, contributed by Miss Mary Gwendoline Caldwell. The institution had productive funds in 1931 amounting to \$2,700,000. The library, which includes over 310,000 volumes, contains the Connolly Collection of Americana and the Ibero-American Library. In 1931-32, there were about 1,300 students who were candidates for degrees, and approximately 2,000 students in neighboring colleges and seminaries. The faculty of 140 was headed by the Rt. Rev. Mgr. J. H. Ryan.

**CATILINE** (c. 108-62 B.C.), a Roman, whose complete name was Lucius Sergius Catilina, famed for the conspiracy bearing his name. After an abortive attempt at revolution, 66-65 B.C., in which even Caesar and Crassus may have been implicated, Catiline, unsuccessful in his candidacy for the consulship of 63 B.C., and rendered desperate by his enormous debts, formed a plot to fire the city of Rome in many places at once, to murder many of the chief magistrates, and seize the city. **MARCUS TULLIUS CICERO**, the consul, fully informed of the conspiracy through private agency, inveighed so violently against Catiline in the senate that the latter fled from Rome into Etruria where an army supported him. Following the arrest and death of many of his fellows in Rome Catiline, attacked simultaneously by Metellus Celer and Gaius Antonius, died fighting bravely.

**CATION**, the name given to the positive ion in **ELECTROLYSIS**. Positive ions naturally move toward the negative electrode, the **CATHODE**, hence the name. Thus, in electroplating, the positive metallic ions travel to the cathode where they are neutralized and deposited as metal. See also **ANION**.

**CATKIN**, in botany, a dense bracted spike of small apetalous unisexual flowers, characteristic of many common trees; also called an ament. In the willows, poplars, birches, and alders both sexes of flowers are in catkins, but only the staminate flowers in the oaks, beeches, chestnuts, hickories, and walnuts. These plants are sometimes termed collectively the *Amentiferae* (catkin-bearers).

**CATLETTSBURG**, a city in eastern Kentucky, the county seat of Boyd Co., situated at the junction of West Virginia, Ohio and Kentucky, on the Ohio River at the mouth of the Big Sandy. Bus lines, rivercraft and the Chesapeake and Ohio Railroad serve the city. Coal and natural gas are found in the region. There are some lumber and iron industries but the city is essentially residential, and within commuting distance of Ashland, Ky., and Huntington, W.Va. George Washington surveyed the country. It was the headquarters of Federal troops during the Civil War. Catlettsburg was founded in 1854 and incorporated in 1858. Pop. 1920, 4,183; 1930, 5,025.

**CATNIP**, called catnep and catmint, an erect branching herb of the Mint family, botanically known as *Nepeta Cataria*, 2 to 4 ft. high, with heart-shaped downy leaves and terminal racemes of pale flowers dotted with purple; native of Europe but extensively naturalized along fences and near houses in the United States. When crushed all parts of the plant have a pleasant aromatic odor, particularly attractive to cats. Catnip tea is an old-fashioned home remedy for colic.

**CATO, MARCUS PORCIUS**, the name of two Roman statesmen. I. Cato the Elder (234-149 B.C.) after holding many major public offices in Rome attained particular prominence during his censorship, 184 B.C., by his firm stand against Greek influences which threatened to undermine the characteristic simplicity of the old Romans. To this end he sponsored many sumptuary laws. In his later years fearful of the reviving power of Carthage he urged its complete destruction. The first important prose writer in Latin, his interesting treatise on agriculture, *De Re Rustica*, is alone extant. Another important work was the *Origines*, a history of Rome. II. Cato the Younger (95-46 B.C.), great-grandson of the former. An influential member of the senate he bitterly opposed all acts of Caesar and Pompey which showed disrespect for the constitution. At last forced to align himself with one or the other of these men in the civil war of 49 B.C. he threw in his lot with Pompey, who at least posed as the champion of the senate. Leading a remnant of the Pompeian forces to Africa after the rout at the **BATTLE OF PHARSALUS**, 48 B.C., and suffering defeat at Thapsus, he died by his own hand at Utica, 46 B.C., rather than to submit to Caesar.

**CATS, JAKOB** (1577-1660), Dutch poet, was born in Brouwershaven, Zeeland, Nov. 10, 1577, and studied law at Leyden, Orléans and Paris. He was active in political life. Cats is remembered chiefly for his poems which were widely popular because, being didactic and platitudinous, they suited the taste of that day. They include *Selfstrijt*, or *Inward Strife*, *Mannelyke Achtbarheyd*, or *Manly Respectability*, and *Houwelyck*, translated as *Marriage*. He died near The Hague, Sept. 12, 1660.

**CAT'S-CLAW** (*Acacia Greggii*), a straggling shrub of the pea family, found in deserts from western Texas to California and Mexico. It grows from 4 to 15 ft. high, with the branches armed with clawlike prickles, and bearing finely divided leaves, small yellow flowers in dense clusters, and long contorted pods. The name is given also to a handsome, yellow-flowered evergreen climber (*Doxantha Unguis-cati*) of the *bigonia* family, native to Argentina and planted for ornament.

**CAT'S-EAR** (*Hypochaeris radicata*), a perennial herb of the composite family, with very hairy leaves somewhat resembling a cat's ear. The plant, a native of Europe and Asia, has become widespread as a weed in North America, especially in California. The slender stems about a foot high, bear a rosette of basal leaves and large, long-stalked heads of bright yellow

flowers, much like those of the dandelion. Of similar range is the smooth cat's-ear (*H. glabra*), with hairless leaves and smaller flowers.

**CAT'S EYE**, a term applied to QUARTZ and CHRYSOBERYL when showing chatoyant effects. In quartz the straight, luminous line shows against a yellow or brown background due to fine, parallel fibers of asbestos included in the quartz. The more valuable Oriental cat's eye is a variety of chrysoberyl in which the line is due to the presence of a twinning plane in the crystal. See also ALEXANDRITE; GEM STONES.

**CATSKILL**, a village and county seat of Greene Co., eastern New York, situated on the west bank of the Hudson River, 35 mi. south of Albany. River craft, ferries, buses and the New York Central Railroad afford transportation. The village is chiefly known as a summer resort although it manufactures bricks, cement and knitted goods. The region is devoted to fruit raising, particularly apples and pears. The Dutch first settled in Catskill about 1680. The village was incorporated in 1806. Pop. 1920, 4,728; 1930, 5,082.

**CATSKILL MOUNTAINS**, a highland region in New York State, covering about 1,000 sq. mi. in Greene, Ulster, Sullivan and Delaware counties. They are not mountains in the structural sense but dissected plateaus as shown by their horizontal strata and while generally included in the Appalachian system, are not a part of that general uplift. The slopes fall off abruptly on their eastern faces and have a gentle decline westward. Their descent into the Hudson valley is exceedingly abrupt, taking the form of a cliff escarpment 1,500 to 3,000 ft. high. The loftiest summits in the range are Slide Mountain, 4,205 ft., Hunter, 4,025 ft., and Black Dome, 3,990 ft. The slopes are well wooded up to the summits with pine, spruce, oak, hickory, rhododendron and mountain laurel. In 1929 176,440 acres of the Catskill region were included in the New York State forest preserve.

These mountains abound in striking scenery provided by their deep gorges or cloves, particularly Stony Clove, Plattekill and Deep Notch; and the numerous high cascades including Kaaterskill, Haines and Devassego falls. They are sparsely settled and used chiefly as a vacation and pleasure region. Washington Irving gave them wide fame by his story of Rip Van Winkle. Their several reservoirs are the principal source of water for New York City.

**CATSKILL PARK**, a state park located in the central portion of the Catskill Mountains in Greene, Delaware, Ulster, and Sullivan counties in southeastern New York. It was created in 1885 and by 1928 had been enlarged to its present area of 167,692 acres. Steep mountains and rugged valleys covered with hardwood forests characterize the park.

**CATT, CARRIE CHAPMAN** (1859- ), American suffrage leader and lecturer, was born at Ripon, Wis., Jan. 9, 1859. She studied at the State College of Iowa and later took a special course in law. She married Leo Chapman in 1884 (died 1886) and

George William Catt in 1890 (died 1905). Mrs. Catt was organizer and state lecturer of the Iowa Woman Suffrage Association 1890-92. In the latter year she became associated with the National American Woman Suffrage Association, being president from 1900-04 and since 1915. In the campaign to submit the woman suffrage amendment to the Federal Constitution (ratified in 1920), she was a recognized leader. From 1904-23 she was president of the International Woman Suffrage Alliance, an organization for which she was largely responsible. Her efforts later were wholly turned to the world peace movement.

**CAT-TAIL** (*Typha latifolia*), a reedlike aquatic plant of the cat-tail family, forming an important part of the vegetation in marshes widely throughout the Northern Hemisphere. It grows stiffly erect, from 4 to 8 ft. high, bearing long flat leaves, longer than the stem, and an immense number of minute flowers in dark brown club-shaped spikes, about an inch in diameter and 3 to 12 in. long, terminating the stem. The creeping astringent rootstocks, rich in starch, form a substantial part of the food of muskrats. These valuable fur-bearers usually abound in greatest numbers in large cat-tail swamps. The leaves are used in cooperage and also in making chair-bottoms and mats. In Russia the young shoots serve as a potherb.

**CATTARO**, Cerbo-Croatian *Kotor*, in the Yugoslav district Zetska in South Dalmatia, lies in the innermost corner of the Bay of Cattaro, which projects deeply into the coast. It has a cathedral of the patron St. Trifun, Roman Catholic and Greek Orthodox bishops, a paved road to Cetinje and would be the natural harbor for Montenegro were it not for the high mountains. The Bocche di Cattaro is a great natural harbor surrounded by precipitous, almost perpendicular mountains. It is surrounded by marvelous Mediterranean vegetation and is a fine harbor for Yugoslavia against Italian Adriatic aims. Cattaro was a Roman colony and in medieval times an independent republic under Byzantine, later Serbian and Hungarian protection. In 1420 it submitted to Venice. In 1707 it fell to Austria, in 1807 to French Illyria and in 1814 to Austria again. In the World War it was a base for Austrian submarines. It was occupied by the Italians in Nov. 1918 and became part of YUGOSLAVIA in 1919. Pop. 1921, 4,810.

**CATTELL, JAMES McKEEN** (1860- ), American psychologist and editor, was born May 25, 1860, at Easton, Pa., where his father was president of Lafayette College. He graduated from Lafayette in 1880 and received his Ph.D. degree from Leipzig in 1886. The professorship in psychology at the University of Pennsylvania, which he filled from 1888-91, was the first of its kind in the country. From 1891-1917 Cattell was professor of psychology at Columbia University. He has been the editor of numerous scientific publications, including the *Psychological Review*, 1895-1905; *Science*, from 1894; *Popular Science Monthly*, 1900; *Scientific Monthly*, 1907, and *School and Society*, 1915. In 1929 he was president of the Ninth International Congress of Psychology.



Cattell has been recognized as one of the foremost among research psychologists and has been prominent in developing methods for measuring psychological traits. In 1921 he was instrumental in founding the Psychological Corporation and became its first president, and later Chairman of its Board of Directors. This corporation is unique, existing solely for the purpose of giving advice along the lines of vocational guidance and promoting scientific research in this much-needed field.

**CATTIE** or **CATTY**, a unit of weight used in the Orient, especially China, which is equivalent to about  $1\frac{1}{3}$  POUNDS avoirdupois.

**CATTLE RAISING** has characterized every stage of human progress and played a major rôle in human development from prehistoric times until the present. Cattle were apparently domesticated earlier than other animals. Certainly they constituted one of the most valued of possessions, a man being rated by the number of animals he owned.

So remote is the origin of domestic cattle that the native wild form is unknown. The most ancient sculptures show that more than 4,000 years ago several different but not highly developed types existed. The nearest extant approach to the original wild form is the wild cattle in Chillingham Park, Northumberland, England. These animals are believed to be descended from the wild ox (*Bos primogenius*) which existed until the 12th century in central Europe.

Progress made in breeding and selecting animals adapted to special purposes and conditions has resulted in there now being more than a hundred distinct breeds.

The most important breeds have reached America from northwestern Europe, especially Great Britain, where Robert Bakewell, shortly after 1750, originated a system founded on the chosen union of parents and careful selection of progeny for further development. His practice was based on the maxim that "like begets like" not only in external or superficial characters but in every detail of the animal's body. In large measure he proved that a breeder may "give expression to his ideal conception of the qualities that constitute perfection."

Although the forms and markings of the various breeds differ more or less widely, the most important result of breeding since Bakewell blazed the way is the tendency of animals to mature at earlier ages than their progenitors, to lay on flesh and fat more uniformly and to produce more milk over a longer period than the needs of the offspring require.

The various breeds of domestic cattle belong to one or other of two general classes, beef cattle and dairy cattle, with a small group of the former also useful as milk producers. These two classes differ strikingly in their conformation as well as in their ability, respectively, to develop flesh or milk.

The beef breeds are rectangular in general outline, broad across the back and deep from back to belly. Refinements have reduced the profitable sizes from those formerly sought and, largely due to the influence

of agricultural colleges and stations, the demand is for quality and finish rather than size. The smaller, quicker maturing, plump animals with minimum waste are more profitable to raise, more economical to dress and far superior to their progenitors as food.

As good and poor beef type animals occur in all the beef breeds it is more important that each animal chosen for breeding and feeding shall conform as nearly as possible to the best market standards than that it belong to any specific breed. As feeders the beef breeds nevertheless have advantages over both natives and dairy breeds because they have been bred and selected for meat.

In America beef cattle are raised either on the open range, where great numbers reduce costs and thus permit small moderate profits, or they are grown in farm feed lots and buildings to attain the greater size and better finish that command highest prices. Often these two plans are combined, the former supplying young animals as feeders and the latter fitting these for market. Pure bred sires, usually farm bred, are used to produce the young stock.

The area west of the Missouri River formerly offered cheap, ideal land for beef raising at a high profit. Settlement, however, has increased the cost and reduced profits so much that the beef territory has moved farther westward and southward. Here large numbers of pure bred bulls have been introduced with the results that earlier maturity, more approved market type and better quality now characterize these sections. The most favored breed there is the Hereford because of its size and stamina and its ability to rustle for its food and to produce heavy carcasses on grass alone. Other favorites are Durham and Aberdeen-Angus.

On range the animals graze during the summer and autumn and during the winter are fed wild and cultivated hay grown mostly on irrigated, bottom land. In the autumn when they come off range the calves born during April are weaned and branded and the males castrated, placed in sheds or behind wind-breaks and fed hay, largely alfalfa. The cows are similarly protected and fed or turned out on winter pasture. In May, when calving is over, the herds are turned out to range.

When two or three years old, range cattle are marketed in the autumn as grass-fed animals, the fattest for immediate slaughter and the thin ones for feeding, mainly by farmers in the corn belt. Here land is high priced and pasture small, but corn is abundant. Profit in this branch depends upon skillful handling and astuteness in barterings. Factors that influence the business are choice of animals of the right type for definite purpose, length of time to be fed, season of the year, feeds used, the market and the feeder's experience.

In America the leading beef breeds are Durham, also called Teeswater and Shorthorn, Hereford, Gallo-way, Devon and Aberdeen-Angus. The most widely famous of these, the Durham or Shorthorn, represents the ideal type of beef animal. They are red

and white or roan and noted for early maturity, excellent beef form, rapid fattening and small slaughtering waste. In addition to these qualities certain strains are popularly known as milking Shorthorns because the cows are better milkers than those of other beef breeds.

Hereford cattle, which originated in Herefordshire, England, have white on the head, tops of the shoulders, bellies and feet. As beef cattle they vie with the Shorthorns, especially in the Southwest, but as milkers they often fail to supply even the needs of their own calves. Galloway cattle, which originated in Scotland, are strongly built, rather squat, black, hornless animals noted for their rugged constitutions and ability to forage. Though highly valued for beef they are poor milkers. Aberdeen-Angus, by Scotsmen affectionately called "Doodies" because of their hornlessness, resemble the Galloways in color but are taller, larger and longer-legged and the cows are better milkers.

Devon cattle, which as their name indicates, originated in Devonshire, England, are noted for their docility, hardiness, ability to forage, responsiveness to good care and for their dual purpose strains. They have symmetrical, beautiful forms and rich red coats, hence the name "Rubies." Although the bulls and cows are somewhat smaller than in the other breeds mentioned, the oxen grow large and are popular as beasts of burden.

Dairy cattle show more remarkable development as the results of breeding, selection and feeding than any other domestic animals except egg-laying strains of hens. (See POULTRY RAISING.) The tendency to lay on flesh has been largely transmuted into ability to produce milk. Systematic breeding to this end has lengthened the milking period to 10 or 11 months instead of the pasture seasons. Many individual cows annually yield 10 or 12 times their weight of milk.

The richness of the milk has been wonderfully increased during the past 40 years by the Babcock test for butter fat. In this test a measured quantity of a cow's milk is placed in a bottle, treated with sulphuric acid, whirled in a machine, which by centrifugal force throws the heavy parts of the liquid to the bottom and leaves the butter fat in the graduated neck, where the percentage is instantly read. This percentage and the weight of the milking show whether the cow being tested is or is not profitable to keep. By breeding from animals that yield large weights of rich milk the productivity of herds has steadily risen so that many cows produce more butter in a week than three or four ordinary cows did before the system began.

This test has also settled the formerly held belief that the milk of certain breeds is superior for cheese making and that of others for butter. Numerous experiments in both cheese and butter production have shown that the butter fat determines the value of milk for each purpose. Hence every breed has its sponsors and its salient valuable points. Even so, in America at least, comparatively few dairy cows are

pure bred. They are mostly crosses between pure bred sires and nondescript cows and are known as grades. Often this is no stigma, for many grades produce as much and as rich milk as their pure bred sisters.

The dairy breeds differ strikingly in form from the beef breeds. They are triangular in outline from front to rear; wedge-shaped from back to belly; more shallow at the shoulders than at the rump and with larger udders than characterize the beef cattle. They also weigh less and their weight represents a greater proportion of bone and a smaller proportion of flesh and fat.

In America the leading dairy breeds are Ayrshire, Guernsey, Jersey and Holstein. The first three are noted for the quality and high percentage of butter fat but the quantity of their milk is smaller in comparison with the fourth.

#### CATTLE ON FARMS, U.S.

5-Year Average, 1927-31

<i>Division</i>	<i>Value Per Head (Dollars)</i>	<i>Number</i>	<i>% of Total</i>
UNITED STATES .....	\$49.49	57,166,000	100.0
LEADING STATES:			
Texas .....	33.66	5,535,000	9.7
Iowa .....	52.72	3,906,000	6.8
Wisconsin .....	67.60	2,989,000	5.2
Nebraska .....	47.84	2,928,000	5.1
Kansas .....	43.12	2,819,000	4.9
Minnesota .....	52.80	2,776,000	4.9
Missouri .....	46.20	2,156,000	3.8
Illinois .....	58.92	2,057,000	3.6
New York .....	86.26	1,919,000	3.4

Ayrshires, which originated in southwestern Scotland, are medium-sized, short-legged, small-boned animals, famous for their ability to thrive "where most other breeds would starve." They are red and white, more or less spotted. The cows are excellent milkers, individual records exceeding 12,000 lbs. of milk and 600 lbs. of butter in a year. Guernsey cattle originated in the Channel Islands from Norman stock which they resemble. They are light and dark brown and noted for the richness of their milk. Individual cows have records of almost 13,000 lbs. of milk, 700 lbs. of butter in a year. Jerseys are the smallest of the four dairy breeds mentioned but in the United States have been bred for greater size than in their Channel Island home. They are mostly cream, fawn, tan, dark brown and almost black with beautiful heads. Their milk is the richest of all. Records of individual cows run annually to 12,000 lbs. of milk and 800 or more lbs. of butter.

Holsteins or Holstein-Friesians, which originated in Holland, are large white and black cattle with rather long legs and often huge udders. They are noted for prodigious milk production, individual cows often giving more than 100 lbs. of milk in 24 hours, more than 13 tons of milk in a year and more than their own weight of milk each month for a full year. The milk is usually poor in comparison with that of the other breeds mentioned, often failing to

meet state and municipal standards. Breeding and selection, however, are improving the Holsteins in this respect so that certain strains now yield milk of moderate richness and fair butter-producing value. Records of approximately 1,000 lbs. of butter fat in a year have been made. M. G. K.

**CATTLEYA**, a genus of tropical orchids comprising about 45 species native to tropical America, several of which are among the most popular orchids grown by the greenhouse florist. They are epiphytes with slender or club-shaped stems, bearing 1 to 3 thick, stiff leaves and one or more large, showy, brilliantly colored flowers.

**CAUCASIAN**, the generic name for two important linguistic families (*see* FAMILY, LINGUISTIC) spoken in the Caucasus area. The north Caucasian family falls into Checheno-Lesghian, with eight subdivisions in the east, and Abasgo-Circassian, with three, in the west. Checheno-Lesghian is marked by a great abundance of consonants, but with aversion to consonant groups, with a relatively meager vocalic system; by sometimes as many as six grammatical genders; by suffixal inflection both of nouns and verbs; by an excessive development of cases (*see* CASE), running to 30 in Avar; by durative and momentary ASPECT in the verb, whose transitive form is in the passive ("brothers-by sold (are) their horses" = "the brothers have sold their horses"); and by counting normally in scores rather than in decades. The general structure of Abasgo-Circassian is the same, except that it affects consonant-combinations and compound words, has a very meager declensional system and lacks grammatical gender.

South Caucasian, or Kharthvelian, comprises GEORGIAN, Mingrelian, Lazian and Svanian. It lacks grammatical gender, but is rich in cases and, like Abasgo-Circassian, has both personal and impersonal verbs, i.e., both "I write" and "to me (is) writing." Since the history of no Caucasian language except Georgian is known, it is scarcely possible to determine whether the northern and southern families may be traced to a single source; but some connection with IBERIAN, and so with BASQUE, is not wholly improbable. L. H. G.

**BIBLIOGRAPHY.**—A. Ditt, *Einführung in das Studium der kaukasischen Sprachen*, 1928.

**CAUCASIAN RACE.** *See* RACES OF MANKIND: *Caucasoid Group*.

**CAUCASUS MOUNTAINS**, a great chain of southeastern Russia, extending from the Strait of Kerch on the Black Sea to the Apsheron Peninsula on the Caspian. They stretch northwest to southeast for about 800 mi., with a breadth varying from 30 to 120 mi. With their western prolongation in the Crimea, this glacier-covered chain is generally considered part of the natural line of division between Europe and Asia. Peaks perpetually capped with ice and snow rise to great heights: Elburz, 18,526 ft. and Kazbek, 16,456 ft. are the best known. The important rivers rising in the Caucasus are the Kuban, which drains into the Black Sea, and the Terek and

Kur, emptying into the Caspian Sea. The chief pass is the Darial, which cuts through a gorge to pass from Vladikavkaz to TIFLIS and is the principal trade route between southern Russia and Asia Minor. The western portion, near the Black Sea, is extremely rugged; in the wide central part rise the loftiest peaks while toward the east the slopes gradually decrease in height. The southern slopes are heavily wooded and the whole range is rich in minerals and wild life. Rich petroleum deposits occur at both ends of the chain. Various grains and tobacco grown in the fertile soil largely support the native population of GEORGIA. Once part of the Roman Empire, the Caucasus Mountain region has been invaded by Khazars, Huns, Avars and Mongols, its inhabitants did not submit to Russian rule until the middle 19th century.

**CAUCUS**, a term which originated in New England, where it was applied in the 18th century to the secret meeting of party or factional leaders for the purpose of reaching an agreement upon policies or candidates for public office. In the 19th century it came to mean meeting of party voters for the purpose of nominating candidates or electing convention delegates. In the United States generally it signifies a meeting of legislators who belong to the same political party and who by this means bind themselves to a common line of action respecting specific matters of legislative business. Before the rise of state and national conventions (*see* CONVENTION, POLITICAL), the party candidates for president and vice-president were nominated by a congressional caucus; and a legislative caucus discharged the same function in the case of governor and lieutenant-governor. In English usage, caucus refers to the local party organizations which made their appearance after the extension of the suffrage in 1867 and which seemed to reflect the practices of the American party machine. E. M. S.

**CAUDLE LECTURE**, a curtain lecture; a rebuke. The term originated in a series of humorous papers published by Douglas Jerrold in the London *Punch*, 1846; in these the nagging Mrs. Caudle delivers a severe lecture every night to her long-suffering husband, Job.

**CAULIFLOWER** (*Brassica oleracea*, var., *botrytis*), a form of cabbage, the most delicately flavored of the seven distinct vegetables developed from the original wild plant. (*See* CABBAGE.) The edible part, called the curd, consists of rudimentary flower stems and buds compacted into somewhat flattened, more or less dense heads. In perfect heads the parts which form the curd appear to be almost homogeneous, but

#### CAULIFLOWER, COMMERCIAL PRODUCTION, U.S. 4-Year Average, 1927-30

Division	Acreage	Production (Crates)	% of Tot. Prod.
UNITED STATES .....	23,138	5,346,000	100.0
LEADING STATES:			
California .....	12,693	3,498,000	65.4
Colorado .....	2,365	776,000	14.5
New York .....	5,627	620,000	11.6
Oregon .....	1,815	339,000	6.3

when grown under unfavorable conditions, or when allowed to become over-developed, the floral parts form and the delicate flavor is impaired. The heads normally become brown from exposure to the sun, but they are easily whitened (blanched) by tying or breaking and laying the leaves over them.

Cauliflower seed is the most difficult and costly of all vegetable seeds to produce, yet with no other crop is high-quality seed of such importance. It insures a far larger percentage of perfect heads than does low-priced seed. Cauliflower plants are less hardy, demand richer, more moist soil, and are more exacting in their cultural requirements than any other of the cabbage group. Hence the crop is grown commercially in only limited areas and is far less often seen in gardens than its close relatives of the cabbage group.

M. G. K.

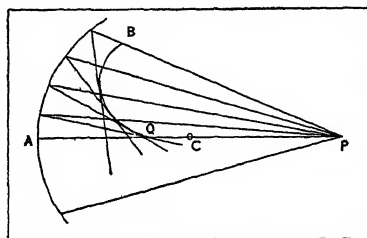
**CAUSALITY**, a logical principle indicating an explanatory connection between events in the temporal series. A causal relation differs from a logical one in that it presupposes a temporal order, whereas logical relations do not involve the element of time.

A causal sequence differs from a mere temporal sequence in that the happening is not a matter of chance. Given the conditions under consideration, a certain event is bound to take place. Any number of events may follow one another in time without there being of necessity any causal connection between them. An automobile ride, a chocolate sundae, a movie and the reading of a novel may follow one another successively, but any number of other happenings might equally well have occurred in the same course of time. A man is shot in an attempted robbery and dies shortly after the shooting. Here there is a definite causal connection between these events. Unless other factors could have been introduced to offset the effects of the shooting, the man's death was inevitable.

Not all causal connections are so obvious. The real difficulty of using the principle of causality lies in determining when there is a determinate connection between things and events. This is the task of science. The causal principle, or the assumption that things will behave in the same manner under the same conditions and circumstances, is one of the presuppositions of modern science. In fact it is upon this assumption that scientific knowledge rests; without it such knowledge would be quite impossible.

**CAUSTIC**. In many optical systems of relatively large aperture, such as spherical mirrors, light coming from a point on the axis is not all brought to a focus at one point. Thus, for a concave mirror with center at C, (see diagram) the rays from P, obeying the laws of REFLECTION, do not intersect at the focal point, Q. But two adjacent rays intersect before reaching the axis, and these points of intersection form a curved line, QB. This line of strong illumination is called the *caustic curve*. The *caustic surface* is the surface formed by rotation of the caustic curve about the axis, AP. All rays leaving P at the same angle with the axis intersect on the axis at the same point, and, thus,

the line, AQ, is a part of the caustic. A ready illustration of a caustic curve is obtained by allowing nearly horizontal light to be reflected from the inner surface of a cup nearly full of milk. Caustic surfaces are produced by convex mirrors, in which case they



BQ IS THE CAUSTIC CURVE FORMED BY INTERSECTING RAYS FROM CONCAVE MIRROR A

are virtual, and by lenses and where spherical waves are refracted at a plane surface (see REFRACTION). It is characteristic of all wave motions. P. I. W.

**BIBLIOGRAPHY**.—R. W. Wood, *Physical Optics*.

**CAUSTIC EMBRITTLEMENT**, a peculiar type of cracking occurring in the steel of steam BOILERS using naturally alkaline feed-water or water treated with excessive amounts of such alkaline substances as lime or soda. While cracks produced in steel solely by mechanical means generally cut across the individual crystals, caustic-embrittlement cracks follow the crystal boundaries. These cracks have been known to occur in many different regions of boilers, but they generally develop in places where a high concentration of dissolved substances might have been built up by local evaporation of the boiler water in a capillary space.

Caustic embrittlement has been attributed to the direct corrosive action of a concentrated caustic solution on steel stressed beyond its elastic limit and to occlusion, by the steel, of hydrogen formed by reaction of the caustic solution with the steel. Also, it has been claimed that there is no such phenomenon as caustic embrittlement, and that the inter-crystalline cracks, said to indicate its presence, may be due to metal fatigue under repeated stresses, such as might be caused by long-continued vibration.

While the exact nature of caustic embrittlement has remained in doubt, practical boiler operators, anxious to guard against any possibility of boiler failures due to this cause, have adopted the practice of maintaining certain sulphate-alkalinity or phosphate-alkalinity ratios in their boilers.

E. P. P.

**CAUSTICS**, chemical substances used to destroy living tissues. Caustics are employed to destroy unhealthy growths, as warts or superficial tumors, and to inhibit the action of organic poison, as in bites and virulent diseases. Caustic substances include lunar caustic (silver nitrate) caustic potash (potassium hydroxide), caustic soda (sodium hydroxide), caustic lime (calcium hydroxide), carbolic acid, and zinc chloride. Hot iron, or other metals heated to white heat (by electricity), destroy tissues through physical

action, by burning. It is from this action that the term caustic (Greek, meaning burning) is derived.

**CAUSTIC SODA**, the commercial name for sodium hydroxide (NaOH). The constants are as follows: specific gravity, 2.13; melting point, 318° C.; boiling point, approximately 1390° C. (white heat); molecular weight, 40.01. It is very soluble in water, soluble in alcohol, ether and glycerine. There are two methods of manufacture, the electrolytic process and the lime process. In the *electrolytic process*, water solutions of common salt are fed to electrolytic cells and subjected to a direct current of electricity. Chlorine is given off at the anode, hydrogen and impure caustic soda are formed at the cathode. The caustic cathode liquor is concentrated in vacuum pans where most of the residual salt separates as a solid. The concentrated liquor is then run into cast iron pots and evaporated to a clear, colorless, molten liquid which is run into steel drums where it solidifies on cooling. The *lime process* depends upon the formation of sodium carbonate by means of ammonia, carbon dioxide and heat, and the conversion of the carbonate to hydroxide with milk of lime. The solid product is sold in drums or barrels and a concentrated solution is shipped in tank cars.

Caustic soda finds its way into many of our fundamental and essential industries. It is used to manufacture soap, rayon, mercerized yarns and fabrics, paper pulp, explosives, dyes, petroleum products and pigments. It is also used for degreasing wool, in reclaiming rubber, in organic fusions and for the cleaning of metals. It is necessary in the production of other chemicals, pharmaceuticals, boiler compounds, water softeners and detergents. *See also SODA.*

A. H. H.

**CAVALCANTI, GUIDO** (1250-1300), Italian poet and philosopher, was born in Florence, in 1250, during the turbulent days of the Guelphs and the Ghibellines. He presumably inherited the philosophical inclinations of his father, to whom Dante alludes in his *Divine Comedy*. On marrying Beatrice, daughter of Farinata Uberti, Cavalcanti became head of the Ghibellines. This position afforded a tempestuous preparation for those "gentle and gracious rhymes of love" comprising the love sonnets and songs lauded by Dante in Canto XI of the *Purgatory*. Besides these *Canzone d'Amore*, there is left some prose work in philosophy and oratory. A political overturn caused the banishment of Cavalcanti to Sarzana, where he died of malarial fever, Aug. 28, 1300.

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**CAVALIERI, LINA** (1874- ), Italian opera singer, was born at Rome in 1874. She made her debut at Lisbon, Portugal, as Nedda in *Pagliacci*, after having achieved popularity as a singer in cafés. Her principal rôles have been in *La Vie de Bohème*, *La Traviata*, *Rigoletto*, *Mignon* and *Fedora*.

**CAVALIERS.** In the English civil wars between the adherents of CHARLES I and the Parliamentarians, the Royalists were called Cavaliers by their oppo-

nents. The term, which is the equivalent of the French *chevalier* and has virtually the same original meaning as the word knight, was applied as an opprobrious epithet; but it was adopted and used by the Royalists themselves during the civil wars and in the Restoration period until the word Tory took its place.

**CAVALLERIA RUSTICANA**, an opera in one act by PIETRO MASCAGNI, libretto based on a story of Giovanni Verga by Targioni-Toggetti and Menasci; première, Rome, 1890, London, Philadelphia and New York, 1891. Submitted in a prize contest, the opera won the award and instantly captivated the public, becoming the most popular one-act opera in the standard repertory. Mascagni was only 27 when he composed it.

Returned from the wars, the rustic Sicilian cavalier Turriddu finds his former sweetheart Lola married to Alfio, a prosperous teamster. He has consoled himself with the sweet and gentle Santuzza, who adores him; but Lola still casts a limpid eye on her first sweetheart who promptly succumbs to his former infatuation. Waiting outside the village church on Easter Sunday, Santuzza accosts Turriddu in the churchyard, pleading with him to be true to her. But at that moment Lola herself passes, mocks Santuzza and carries the cavalier off with her into the sanctuary. Trembling and tearful Santuzza starts to follow, but falls on the church steps just as Lola's husband Alfio appears. In despair she stammers out the story of Lola's infidelity. Together, in a mood of Sicilian vengeance, Alfio and Santuzza quit the scene, and the famous intermezzo follows before Turriddu and Lola emerge from the church with the other worshippers. But Alfio now returns alone. He is offered wine by Turriddu who is in high good spirits. Pointedly, he refuses it, and he challenges the cavalier to a duel. To the wailing of the horrified women, Turriddu falls under the thrust of Alfio's bright stiletto.

**CAVALRY**, that branch of the army which is composed principally of mounted troops trained to fight on foot or on horseback. Prior to the advent of quick-fire artillery and automatic-fire small arms, cavalry possessed little fire-power and it usually fought mounted with the saber or lance, charging with the horse to close with the enemy. Cavalry is still trained for the mounted charge, but, with modern firearms, such action is exceptional. The superior characteristics of cavalry are its mobility, especially across country, and its ability to engage in combat either mounted or dismounted.

Modern cavalry is usually a combination of horse elements and armored motor elements, as armored cars and light tanks. The horse elements are armed with the saber and pistol for use of the individual trooper in mounted combat, and with the rifle, automatic rifle and machine gun for dismounted combat. The motor elements are armed with the machine guns and small quick-fire guns.

Cavalry is usually organized into CORPS of three DIVISIONS each, divisions of two BRIGADES each, bri-



gades of two regiments each, and regiments of four squadrons of about 150 men each.

Infantry corps and infantry divisions (*see* INFANTRY) frequently have cavalry as an integral part thereof. Such cavalry is called corps cavalry or divisional cavalry. This should not be confused with the cavalry corps or the cavalry division, which are independent bodies of cavalry to which are usually attached aviation, field artillery, engineers, signal and chemical warfare troops.

The part which cavalry plays in warfare where most of the fighting is done from intrenched positions, is not as effective as in open warfare where its importance increases with its fire-power. G. V. H.

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**CAVALRY OPERATIONS.** The characteristics of CAVALRY which distinguish it from other arms are its superior mobility and its ability to engage in combat either mounted or dismounted. Consequently, its operations are characterized by mobility, fire-power and shock action, mounted action being exceptional under modern conditions. Its mobility permits it to operate over a wide area and at a great distance from other forces, to strike, to change position or direction and to withdraw and strike again.

The primary mission of cavalry is to provide for the army a mobile combat element. Its characteristics dictate the operations on which it normally is engaged and include reconnaissance and counter-reconnaissance, i.e., obtaining information of the enemy and keeping him from obtaining information of his opponent; providing security for other forces, on the march, at the halt and in battle; offensive and defensive action in cooperation with other arms in battle; delaying hostile forces or holding terrain of tactical importance until the arrival of other friendly forces; flanking and turning movements; keeping communication between other friendly forces; exploitation of a break-through in the enemy's line of battle; pursuing a retreating enemy; covering the withdrawal of friendly forces; raiding the enemy's lines of supply; and providing a mobile reserve for the army. Cavalry operations must be conducted with an offensive spirit, combined with the utmost development of initiative, mobility and fighting power. *See also* TACTICS. G. V. H.

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**CAVE**, a subterranean cavity in the earth or rocks. Sea caves are more or less deep recesses worn in the base of cliffs by the alternate smashing and sucking of the surf. Fingal's Cave, in the island of Staffa, is a striking example. Quarried out of columnar basalt, it extends inland for 200 ft. and is 50 ft. high. Sea caves are numerous on the California coast and in the Pictured Rock region of Lake Superior.

In limestone formations in Indiana and Kentucky, immense subterranean caverns have been worn in the rock by the solvent action of groundwater. One of the largest of these, Mammoth Cave, consists of an intricate system of passages and chambers, weirdly hung with stalactites and pillared with stalagmites

formed from dissolved limestone, which extends for 100 to 200 miles.

Caves and rock shelters, especially in France and Spain, have preserved evidence of supreme importance of the art and life of primitive man. *See also* CAVE DWELLERS.

**CAVEAT EMPTOR**, a common law maxim of Latin origin which represents a legal rule in the purchase and sale of land or goods to the effect that the buyer purchases at his own risk, as far as the title and quality of the property acquired by him are concerned.

**CAVE DWELLERS**, the designation of Paleolithic men who were forced by the third glacial period in Europe, about 300,000 years ago, to seek shelter in natural caves. Two distinct types are named from the localities of discovery: (1) the Neandertal, lower than any existing men; (2) the Cro-Magnon, equal to the highest modern race. Some caves are filled with layers of debris from floor to roof, 10 to 30 feet deep, containing human and animal bones, charcoal, ashes, stone and bone implements, the lower layers often being sealed over by a solid stalagmitic pavement. The species of the animals indicate the changes of climate from subarctic to subtropical and back. These pioneers lived by hunting and fishing, clothed themselves with skins, protected and warmed their caves by fires and carefully buried their dead. The Cro-Magnons, who flourished about 25,000 years ago, left many wonderful drawings, paintings and sculptures on the walls of their caves. *See* ARCHAEOLOGY.

**CAVELL, EDITH LOUISA** (1865-1915), English nurse, was born in Norfolkshire, Dec. 4, 1865. She took nurses' training in London Hospital and in 1907 became matron of a nurses' training school in Brussels. This institution became a Red Cross hospital in 1914, and in 1915, during German occupation of Brussels, she was arrested and tried for helping British and Belgian soldiers escape. She confessed to this charge and received a death sentence and was shot, Oct. 12, 1915, an act which brought forth bitter condemnation of the Germans. In 1919 her body was taken to England and buried in Norwich Cathedral after a service in Westminster Abbey.

**CAVENDISH, HENRY** (1731-1810), English chemist, was born at Nice, France, Oct. 10, 1731. He was educated at Cambridge but did not take a degree, retiring to conduct private experiments. His first scientific work was published in 1764. Cavendish established that water was a compound of oxygen and hydrogen and gave the first expression of the laws of chemical valency. He measured the atmospheric pressure and the density of the earth, and proved the production of carbon dioxide by plants. Passing electrical sparks through air he discovered that he had produced salts of nitrogen, but this type of process was not used for the commercial production of nitrates for a century. Cavendish, however, always subscribed to the phlogiston theory of chemistry, considering hydrogen to be that universal underlying substance. He died in London, Feb. 24, 1810.

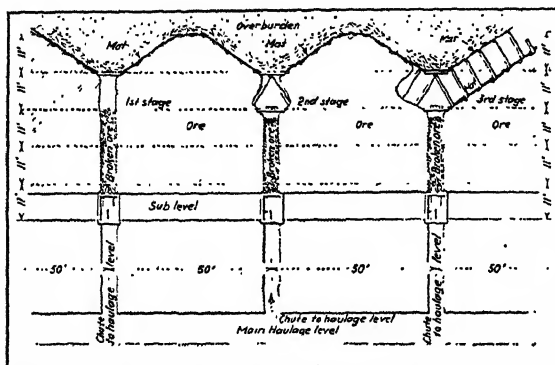
**CAVESSON**, an instrument used for training horses. Essentially, it is a bridle with the bit replaced by a metal band which fits snugly around the horse's head just above the nostrils. To the front of this band is attached a long rope called a longe.

C. V. H.

**CAVIAR**, a food prepared from the roe of the sturgeon. After the ovaries have been taken from the fish, the eggs are separated from the tissue by beating and pressing through a sieve. They are then salted and pressed. The best quality of caviar is sold as an almost liquid granular substance. The commoner variety is a more solid, harder pressed substance. Caviar is usually used as a hors d'œuvre or as a flavoring for other foods.

**CAVING**, in mining, a method of ore extraction in which a block of ore is weakened by removing part at the bottom, and thus allowed to break down by its own weight or by pressure of the overlying material. This method is applicable in large scale operations, in wide veins or thick beds and where the ore is weak and fractured. Caving is conducive to low costs and permits the exploitation of large, low grade ore deposits. The broken ore is allowed to fall through chutes to a lower level, where it is trammed to the shaft.

Top slicing is best suited to deposits of large horizontal dimension and overlain by material which caves readily. The ore body is mined downward from the top in horizontal slices, and each slice is worked inward from the boundaries. The individual



FROM C. A. MITKE, MINING METHODS, MCGRAW-HILL BOOK CO.

INCLINE TOP-SLICING SYSTEM OF MINING

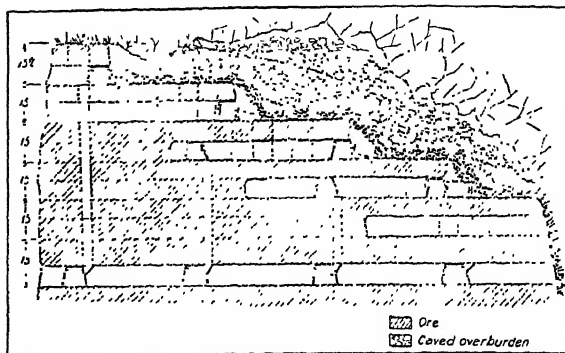
slice is divided into rooms; when a room is finished, the timber props are pulled out and the roof is allowed to cave.

In block caving, the ore body is divided into large blocks, and each block is traversed by intersecting workings. The remaining **PILLARS** are blasted and the weight of the block then causes it to fall and break up.

Branch raise caving is a block caving method in which a special type of **RAISES** are put in under the block of ore at an angle which allows the flow of broken ore through them to be easily controlled. These so-called branch raises are driven up from a

**DRIFT** and divide into smaller raises which in turn branch into "finger raises."

Sub-level caving consists, essentially, of driving intermediate **DRIFTS** and **CROSSCUTS** between the main levels, extending them from the main raises. These workings leave pillars of ore between the different



FROM GEORGE J. YOUNG, THE WORKING OF UNSTRATIFIED MINERAL DEPOSITS, MCGRAW-HILL BOOK CO.

SUB-LEVEL CAVING METHOD

sub-levels. Mining begins at the highest sub-level, and as the work descends, timber and ore accumulate over the workings, exerting a pressure and helping to break the ore. See also **MINING, METAL.** B. L.

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**CAVOUR, CAMILLO BENSO DI, COUNT** (1810-61), Italian statesman, the younger son of a Piedmontese family of Turin. He was trained for a military career as an engineer, but, because of his antagonism to Charles Albert, who succeeded to the throne in 1831, Cavour resigned his commission (1831) and devoted himself to study and foreign travel. In France and England, his liberal ideas became confirmed. From his observations he became convinced of the possibility of conducting historical monarchies on liberal principles. From lectures by Michael Chevalier, which he heard in Paris, and from the works of classical economists, which he read in England, he became a firm believer in the doctrines. He did not think, however, that national wealth would result automatically from the abolition of tariffs and other state restrictions, but he believed that it would grow according to the ability of a state to produce. With this in mind, he studied agricultural, industrial and commercial improvements in both Great Britain and France, for he had ambitions for making Italy a more powerful nation.

Upon his return, he introduced, on his father's estates, ideas which he had obtained in England concerning the rotation of crops, artificial fertilizers and farm management. For the most part, his experiments were eminently successful, and he became a leader in the economic life of Piedmont. He entered commerce and manufacturing, was influential in the construction of railways, founded a steamboat company on Lake Maggiore and helped to establish banks. "There was not an undertaking in which he was not interested. The creation of vast factories, the introduction of gas

in the principal cities of the kingdom, the importation and exportation of grain, silk and wine production and speculation on the exchange . . ." were all matters in which he was vitally concerned.

His active rôle in politics began in 1847 when he founded, at Turin the famous newspaper, *Il Risorgimento*. He advocated the strengthening of the economic sinews of Italy and national unification. He soon became a conspicuous figure, for the concreteness and practicability of his suggestions stood out in bold relief against the fanciful proposals of such romantic politicians as Mazzini. When revolutions broke out in 1848, his propaganda for a constitution in Piedmont was successful. In the same year, he was instrumental in getting Sardinia to go to the assistance of the Lombards who had revolted against Austria. The defeat of the Italians, despite their first victories, led to general discouragement and to the abdication of Charles Albert in favor of his son, Victor Emmanuel II, who later became Victor Emmanuel I of Italy. Cavour, however, did not lose faith in the future of Italy, and he laid plans for the realization of his dreams.

Cavour's first experience in parliament came in 1848, when he was chosen as a Conservative. He was defeated in the elections of 1849, but he was reelected again in 1850. He served in the cabinet of the romanticist Massimo d'Azelio, but withdrew following a quarrel with the premier. He later returned to office and became Prime Minister in 1851. During the whole 1850-60 decade, the decade of resistance, Cavour was in power, and it was he who prepared Sardinia for the coming struggle and stimulated Italian patriotism by his propaganda. He continued to encourage the economic development of the country, and as a result of his efforts Sardinia adopted free trade and a system of direct income and inheritance taxes. In foreign relations, his first move toward strengthening Italy's position was to ingratiate himself with France and Great Britain by aiding them in the Crimean War. At the Peace Congress of Paris following that conflict, he won sympathy for his cause by voicing his country's grievances. In 1858, by the Agreement of Plombières, he secured the promise of the aid of Napoleon III in a war on Austria. In the war which ensued in 1859, the French did join the Sardinians and North Italians in defeating the Austrians. But Napoleon contrary to his bargain with Cavour, made a separate peace with the enemy by which Lombardy was united with Sardinia but Venetia was left under Austrian rule. Cavour was furious at the turn events had taken and resigned, but at the same time advised the revolutionaries who had taken up arms against the Austrians in Tuscany and the other duchies to hold their ground. In January, 1860, he returned to office and secured Napoleon III's approval of the union of the central duchies with northern Italy, Nice and Savoy, now going to France. Later in the same year, he countenanced Garibaldi in the campaign for the conquest of the Kingdom of the Two Sicilies and sent Piedmontese troops to occupy

part of the Papal States. It was only by the cleverest maneuvering that Cavour was able to restrain Garibaldi from attacking Rome, a move which might have led to international complications that would have jeopardized Italian unification. Cavour's wily diplomacy succeeded in holding back the army of red shirts and in obtaining a plebiscite by which Sicily and Naples joined North Italy. In 1861, Cavour was able to witness the realization of his great ambition—Italy united under the house of Savoy. His inability to win Venetia and Rome, alone marred his triumph. The strain that he lived under during these ten eventful years taxed his strength heavily, and he died after a short illness, June 6, 1861. S. B. C.

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**CAVY** (*Cavia*), a name given to several small South American rodents, one of which is assumed to be the ancestor of the domestic guinea-pig. They are characterized by small ears and total absence of a tail. The Patagonian cavy (*Dolichotis patagonica*), or mara, which has a short tail turned to one side, is not a true cavy, having longer limbs and ears and bearing a superficial resemblance to the hare in both appearance and habits. The restless cavy of Brazil, Uruguay and Paraguay measures 10 in. in length and weighs a pound. Cutler's cavy, common in the La Plata Valley, and the rock cavy of Brazil are smaller. The last-named lives in crevices among the rocks while the others construct burrows for their homes. The general tone of their color is brown. They feed evenings and mornings on roots and greens and breed twice a year. One species of cavy is aquatic.

**CAWNPORE**, a city of India and capital of the district of the same name, situated about 115 mi. northwest of Allahabad, on the Ganges. An important railroad center, Cawnpore is important in commercial and military affairs, and has manufactures of leather and cotton goods. During the Sepoy Mutiny, 1857, it was the scene of probably the most brutal atrocities of the rebellion, Nana Sahib murdering several hundred European men, women and children. Pop. 1921, 216,436.

**CAWNPORE MASSACRE, THE**, a massacre in the city of Cawnpore in the United Provinces of India during the Sepoy Mutiny in 1857. After withstanding a siege of 21 days the English commander, Gen. Wheeler, surrendered to the mutineers on a promise of safe conduct for his garrison, and for some 600 British residents, mostly women and children, who had taken shelter with him. After the surrender all were butchered.

**CAXIAS, LUIS ALVES DE LIMA Y SILVA**, Duke of (1803-1880), Brazilian soldier and statesman. In 1839 he was named governor of Maranhao and

was later promoted to brigadier general. In 1851 he served in the war waged against the Argentine dictator, Rosas, and in 1856 became president of the council, but resigned a year later. Recalled in 1861, he formed a cabinet which was overthrown the following year. In 1866 he received the command of the Brazilian army in Paraguay, and a brilliant campaign resulted in the capture of Asuncion in Jan. 1869. Resigning shortly after, he was given the title of duke, with the unique honor of being the only Brazilian ever rewarded this title. From 1875 to 1878, he was president of the council and minister of war, but again resigned on account of ill health.

**CAXTON, WILLIAM** (1422-1491), the earliest printer in England, came of a good Kentish family and was apprenticed to a dealer in silk fabrics. His master, Robert Large, died in 1441, but Caxton continued in the silk trade, being admitted to the Mercers' Company of London in 1453 and sent to Bruges. Ten years later he was appointed acting governor of



CAXTON'S DEVICE

His mark, identifying all of his books

the Merchant Adventurers, a London Association, where his official duties forced him to travel. In this manner he encountered printing at Cologne in the summer of 1472 and set himself to learn the new trade. Shortly before he had had official dealings with Charles the Bold, Duke of Burgundy and his wife, Princess Margaret, sister of Edward IV. Margaret attached him to her household and induced him to proceed with printing. A press was set up at Bruges and in 1474 at the request of Margaret he printed his own translation of de Fevre's *Recuyell of the Historyes of Troye*. Caxton continued printing at Bruges until 1476 when he returned to England and set up his press at Westminster, his first known work in England being an *Indulgence* printed for Abbot Sant, December 13, of that year. His first book appeared the following November, *The Dictes and Sayenges of the Phylosophers*. Thereafter he printed considerable commercial work, as the writings of Chaucer, Gower, Lydgate, a translation of Boethius, and his own translation of the *Legenda Aurea*, illustrated with many woodcuts. Details of his marriage and death are obscure. Winkyn de Worde succeeded to his press.

**CAYENNE**, capital, only seaport and important town of French Guiana, situated at the north end of an island at the mouth of the Cayenne River. The first settlement was made here in 1604, and the town was long used as a place of banishment for troublesome political offenders of France and as a penal settlement for criminals and convicts sentenced to more than eight years' hard labor. The presence of the penal establishment proved no small deterrent to the progress of the country, as French emigrants

were reluctant to seek new homes in a land with a bad name.

The city is laid out in squares. Being well exposed to the marine breezes Cayenne is naturally a healthy place, and the reputation it earned for insalubrity is mainly due to the miasma arising from the stagnant waters of the neighboring canals. Formerly, to have been sent to the prison of the colony meant death from one of the numerous tropical maladies, most of which have now been eradicated. Transportation of convicts to Cayenne has now ceased. There were 6,500 convicts in the prison in 1926.

The harbor, which is accessible to vessels drawing only 14 ft., is somewhat exposed to the north winds, and the shipping has occasionally been wrecked on the neighboring rocks. The products of the country, gold, sugar, rum, coffee and cacao, are shipped in considerable quantities. Pop. 1926, 13,936.

**CAYENNE PEPPER**, a variety (*Capsicum frutescens* var. *longum*) of the red pepper, called also long pepper. It has been developed by cultivation from a shrubby perennial of the nightshade family native to tropical America. The smooth, erect, widely branching stems bear oblong leaves, greenish-white flowers and a drooping, podlike, many-seeded berry, sometimes a foot long. The very hot, pungent powder known as cayenne pepper is made by drying and grinding the fruit or seeds.

**CAYUGA**, an Indian tribe, a member of the League of the Iroquois, speaking a language of the same stock, with its much depleted population now scattered in Ontario, Canada, in Oklahoma, New York and, with the Oneida, in Wisconsin. Their aboriginal habitat was on the shores of Lake Cayuga, N.Y. Like the other Iroquois tribes they had a clan organization which was said to have been the model for the Iroquois confederacy.

**CAYUGA, LAKE**, one of the Finger Lakes in the region of New York which drains into Lake Ontario. It is long and narrow with a surface area of 75 sq. mi., a depth of 400 ft. and an elevation of 381 ft. above sea level. At its head is a delta-like plain upon which the city of Ithaca is built. Near here on Taughannock Creek is the Taughannock Cataract, the highest in New York, which drops in an unbroken sheet 210 ft. just before the creek reaches the lake. At its northern end it drains into the Seneca River and thence into the Oswego River and Lake Ontario. Its valley is a fertile fruit-growing region.

**CAYUSE**, an American Indian tribe speaking a language of the WAILATPUAN stock and formerly closely associated with the Nez Percé and Wallawalla. Their home, when first encountered, was at the headwaters of the Wallawalla, Umatilla and Grande Ronde rivers, and from Blue Mountains to Deschutes River in Washington and Oregon. The survivors of the tribe, never powerful numerically and now much interbred with other tribes and whites, are on the Umatilla Reservation in Oregon. The tribe gained a certain notoriety for the murder in 1847 of the famous missionary, Marcus Whitman, who they believed

caused an epidemic of smallpox. After the introduction of the horse by whites, the Cayuse bred horses and thus the name has been extended to mean an Indian pony, particularly in the northwestern Pacific Coast States.

**CAZIN, JEAN CHARLES** (1841-1901), French landscape and figure painter, was born May 25, 1841, at Samer, Pas-de-Calais. He was strongly influenced as an art student in Paris by the work of the Barbizon School, and on returning from England, where he spent four years (1871-75) designing ceramics, he began his career as a painter of poetic landscapes chosen to illustrate stories from the Bible. The best-known are *Hagar and Ishmael*, in the Luxembourg, and *The Flight into Egypt*. Later his interest was predominantly in the landscape itself, the figures being of less importance, as in the *Souvenir de Fête*, and *The Bathers*. Excellent examples of his work hang in the Metropolitan Museum, New York, and in the Chicago Art Institute. Cazin died near Toulon, France, Mar. 27, 1901.

**CEANOTHUS**, a numerous genus of shrubs and small trees of the buckthorn family. There are some 50 species, native to North America and found chiefly in the Pacific coast region. Several cultivated forms are planted for their attractive flowers. About 30 species occur in California, being especially abundant in the CHAPARRAL, of which the red-heart (*C. spinosus*), the jim-bush (*C. sorediatus*), the buck-brush (*C. cuneatus*) and the white-thorn (*C. divaricatus*), are important members. On the Pacific coast also are the Oregon tea-tree (*C. sanguineus*), the California lilac (*C. thyrsiflorus*), and the tobacco-brush (*C. velutinus*). Two species grow wild east of the Rocky Mountains, the New Jersey tea (*C. americanus*) and the red-root (*C. ovatus*).

**CEARA.** See FORTALEZA.

**CECHY.** See BOHEMIA.

**CECIL, WILLIAM, LORD BURLEIGH** (1520-98), English statesman, was born at Bourne, Lincolnshire, Sept. 13, 1520. Secretary of State under Edward VI, he was deposed during the reign of Mary but reinstated on the accession to the throne of Elizabeth. The queen gave to him the title of Lord Burleigh, Knight of the Garter and Lord High Treasurer, and from 1572 on he was the principal minister to Elizabeth. Cecil supported the religion of the State, negotiated the treaty of Edinburgh in 1560 and persuaded the queen to side with the Netherlands in the war against Spain. He organized the defense when England was threatened by the Armada of Philip II and controlled the queen's policies to selfish ends. He died Aug. 15, 1598.

**CECILIA, ST.**, an early Christian martyred at Rome in 230. To select from the many legends concerning her, she appears to have been compelled to marry a young nobleman, Valerian, in spite of a vow to chastity. She is said to have been able to win him to her views and to Christianity, for which they both died. She is generally considered the patron of church music, following the legend, "while the musicians

played at her nuptials, she sang in her heart to God only." She is usually represented in art with musical instruments: examples are the frescoes of Domenichino in San Luigi dei Francesi, Rome; Raphael's *Saint Cecilia* in the Accademia at Bologna; Ruben's *Saint Cecilia* in Berlin; and the paintings of Rossetti and others. Allusion is made to her in Tennyson's *The Palace of Art*, Dryden's *Ode for St. Cecilia's Day* and in the Second Nun's tale of Chaucer's *Canterbury Tales*. In the Latin and Anglican churches her festival is kept on Nov. 22.

**CECROPIA MOTH**, the largest species (*Samia cecropia*) of the family *Saturniidae*, or giant silkworms. Adults may have a wing expanse of 6 in. Their wings have a ground color of dusky brown, with the outer margins clay-colored. Near the center of each wing is a crescent-shaped lighter area bordered with red. A broad wavy band of red, bordered by white on the inner side, extends across each wing parallel to the margin. Each front wing bears a dark eye-spot near its apex. The body is reddish brown, with each abdominal segment margined with white. The larvæ feed on many forest, shade and fruit trees. When mature, the larvæ are bluish green in color, and bear six rows of tubercles extending the length of the body. Near the head are coral-colored tubercles. Most of the dorsal tubercles are yellow, the lateral ones blue. When ready to pupate, the larvæ spin cocoons. These are large silken bags fastened by one side to a twig or other support.

J. R. T.

**CECROPS**, in Greek mythology, the first king of Attica. He was said to have divided the people into 12 communities and to have given them laws concerning marriage and property. He abolished the sacrifice of blood and instituted the burial of the dead. He was also thought to have invented writing.

**CEDAR**, the name given to various coniferous trees. The true cedars (*Cedrus*) include the cedar of Lebanon (*C. libani*), mentioned in the Bible and prized since ancient times for its durable red wood; the deodar cedar (*C. deodara*), of the Himalayas, widely grown for ornament, and the African cedar (*C. atlantica*), of the Atlas Mountains. In the United States several native conifers are commonly known as cedar. The white cedar (*Chamaecyparis thyoides*) occurs in the southeastern states, the yellow cedar (*C. nookatensis*) on the northern Pacific coast, and the Port Orford cedar (*C. Lawsoniana*), in Oregon and California. The arbor-vitæ (*Thuja occidentalis*) growing in the eastern United States and Canada, is known as northern white cedar and the giant arbor-vitæ (*T. plicata*), of the Pacific Northwest, as western red cedar. Many junipers are likewise called cedar, as the red or pencil cedar (*Juniperus virginiana*) and the desert white cedar (*J. californica*), a rare yewlike tree (*Torreya taxifolia*), of the southern United States, is known as stinking cedar. The nut pine (*Pinus Cembra*) of Europe and Asia is called Siberian cedar. The so-called Spanish cedar (*Cedrela odorata*), which furnishes a fragrant wood extensively



used for cigar boxes, is not a conifer, but belongs to the mahogany family. A. B. J.

**CEDAR BIRD**, the name commonly given to the North American waxwing (*Bombycilla cedrorum*), a small crested bird with sleek grayish-brown plumage, so-called because of its fondness for the fruits of the cedar or juniper. See **WAXWING**.

**CEDAR CREEK, BATTLE OF**, Oct. 19, 1864, a desperate engagement of the **CIVIL WAR**. While his army of 30,000 Federal troops encamped at Cedar Creek, 20 miles from Winchester, Va., Gen. Sheridan proceeded to Washington for consultation with Gen. Halleck. Gen. Early, having strengthened his army since the disastrous **BATTLE OF FISHER'S HILL**, reentered the Shenandoah valley with about 30,000 Confederate troops. In an early morning fog the Confederates attacked, taking the enemy by complete surprise. Hastily formed under Gen. Wright, commanding in Sheridan's absence, the Federal army retreated from its camps with a loss of 1,500 men taken prisoners. Sheridan, opportunely returned to Winchester, encountered the fugitives and trains. On a run to the rear, arresting the flight and infusing vigor into the army, he turned the tide of battle. Many Confederates had left their colors and were plundering the Federal camps when the Union charge swept them off. By nightfall the Confederate army had been driven in confusion from the valley. The Union loss, in addition to the prisoners taken in Early's first charge, was 4,070 men; the Confederate loss, about 3,000.

**CEDAR FALLS**, a city in northeastern Iowa, in Black Hawk Co., situated on Cedar River, 7 mi. northwest of Waterloo. Bus lines, an electric railway and four railroads serve the city. Corn, alfalfa and live stock are produced in the rich agricultural region. Machine shop products are the chief manufactures. The Iowa State Teachers College, with an enrollment of more than 2,500 students, is located here. Cedar Falls was settled in 1843 and incorporated in 1851. Pop. 1920, 6,316; 1930, 7,362.

**CEDAR MOUNTAIN, BATTLE OF**, Aug. 9, 1862, an engagement of the **CIVIL WAR**, in Virginia. Gen. Jackson, commanding a Confederate expedition into northern Virginia, with less than 20,000 troops fought Gen. Pope's Federal army of 32,000 men, ultimately winning a brilliant victory after apparent defeat. Jackson's losses were 2,500 against Federal casualties of 1,400. At the arrival of Federal reinforcements under Gen. Sigel, Jackson halted the attack, and after two days' rest retreated.

**CEDAR RAPIDS**, a city in Linn Co., eastern Iowa, situated on Cedar River, 219 mi. west of Chicago. Six railroads make it an important shipping center for farm products and live stock. Airplanes and bus lines also serve the city. The rapids of the river supply waterpower for the numerous industrial projects of the city. Cedar Rapids has cereal mills, machine shops, packing houses and various other manufacturing establishments. In 1929 the factory output reached an approximate total of \$94,000,000;

the retail trade amounted to \$34,788,249. The city is the seat of Coe College. Cedar Rapids was founded in 1838 and incorporated in 1856. The city has a Commission form of government, housed in a million-dollar Memorial Building. Pop. 1920, 45,566; 1930, 56,097.

**CEDARTOWN**, a city in northwestern Georgia, the county seat of Polk Co., 52 mi. northwest of Atlanta. Two railroads serve the city. The natural resource of the vicinity, especially iron and manganese, are important industrially. The chief manufactures are lumber and cotton products, rubber tires, paper and railroad shop products. Cedartown was incorporated in 1850. Pop. 1920, 4,053; 1930, 8,124.

**CELANDINE** (*Chelidonium majus*), a loosely branching herb of the poppy family, 2 to 4 ft. high, bearing deeply cut leaves and bright yellow flowers. It is a native of Europe, often found in old gardens, and has run wild from Maine to Ontario and southward. The plant contains a poisonous saffron-colored juice sometimes used in medicine. The figwort buttercup (*Ranunculus Ficaria*), is known as lesser celandine.

**CELAYA**, a city of south central Mexico, situated about 2 mi. from the Laja River, in the state of Guanajuato, at an elevation of 5,673 ft. above sea level. The Mexican Central and the Mexican National railroads intersect at this point. The Church of Our Lady of Carmen, with its Corinthian portico, is well known throughout the republic. The main plaza is laid out as a formal garden. The city was founded by 16 Biscayan families in 1570, and named Zalaya, meaning "level land" in Basque. Its industries include the manufacture of woolens, soap, saddles, and the famous Celaya candies (*dulces*). It has a very attractive market where tropical fruits are sold. Pop. 1921, 24,035; 1930, 46,909.

**CELEBES**, one of the large islands of the Dutch East Indies, situated to the southeast of Borneo and separated from it by the Strait of Macassar. It is bounded on the north by the Sea of Celebes, which divides it from the Philippines; on the south by the Sea of Banda and the Sea of Flores, dividing it from the groups of islands of the same name. The area of Celebes is 69,255 sq. mi.; with the adjacent islands, 77,855 sq. mi. The population in 1927 was 3,448,774. The inhabitants belong to the ethnographic and linguistic Malayo-Polynesian group.

Of crocodile shape, Celebes is composed of four peninsulas connected by narrow tracts of land and divided by the Bay of Boni on the south, the Bay of Tolo on the east and the Bay of Tomini on the southeast. Coastal development is abnormal in comparison with the area; the island's length is 800 mi., coastline 2,000 mi., and its breadth at one point narrows to almost 20 mi.

Celebes is traversed from south to north by a range of volcanic mountains. The northern portion is the more mountainous, although the isolated peaks are not so high in the south. Thus Gunung Kalabat, at the northern extremity of the range, attains a height

of only 6,620 ft., although Lomp Batang in the extreme south reaches over 10,000 ft. On narrow tracts of land, the rivers have scarcely room to develop, and almost without exception are extremely short, although swollen during the rainy season.

The central position of Celebes, its shape and its physical characteristics have combined to make it the healthiest of all the large islands of Malaysia. The shape of the island is such as to admit healthful sea-breezes to nearly its entire area, and the absence of low-lying plains renders malaria far less common than in other adjacent islands. But the climate is extremely hot and less uniform than that of Java or Sumatra.

The flora is rich and varied because of the maritime situation, the fertility of the volcanic soil and the equatorial position of the island. It is as plentiful on the plains as on the mountains; but its character, which is Indian in the western portion, tends to the Australian on the eastern slopes. Palms of all sorts, camphor trees, cinnamon, nutmegs, cloves, tree ferns and countless varieties of orchids are found intermingled. The immense forests of the interior furnish many kinds of timber. Tobacco and coffee grow excellently; in Celebes is found the anchor tree, *Antiaris toxicaria*, from which *upas*, a deadly poison, is drawn.

The fauna of the western portion of the island includes the buffalo, the wild bull, the Celebes boar, which is particularly ferocious, many deer and a species of monkey. On the eastern slopes of the island are the marsupials which abound in New Guinea and Australia. In the north is a special antelope, the *anuang*, or "cow of the woods," whose flesh the natives eat almost daily; among the domestic animals are some excellent small horses. There are hosts of butterflies and many birds of dazzling color. The principal crops grown are rice and maize; sugar cane and vegetables are also raised. Chief exports are coffee, rubber, nutmegs and kapok. Gold is mined, and deposits of nickel, iron, copper, lead and coal are found on the island.

The Portuguese settled in MACASSAR in 1625. In 1660 the Dutch drove them out and replaced them, but it was not until the 19th century that the whole island was subjected to Dutch rule. Celebes and its dependencies form two distinct administrative units: the government of Celebes with dependencies, and the residency of MENADO. Macassar, the residence of the governor, is the chief port and trade center.

**CELEBES SEA**, an almost circular body of water in the East Indies. It is bounded in the west by Borneo; in the northwest by the Jolo Archipelago, which separates it from the Jolo Sea; in the north by Mindanao Island; in the east by a chain of small islands, and in the south by the northern arm of the Celebes. The greatest depth of this sea is about 17,000 ft.

**CELERY**, an important vegetable of temperate climates, developed from the European wild celery (*Apium graveolens*), a biennial plant of the parsley family. Under cultivation the plant has developed in

two main types: "turnip-rooted" celery or "celeriac" largely grown in Europe, and true celery, the naturally green leaf stems of which are artificially brought together and whitened (blanched) either by hilling up with earth or by means of boards, tile, paper or other materials to exclude light. The many varieties of the latter group offered by seedsmen vary in height from 1 to 3 ft. and some have pink stalks. Celery is usually eaten raw with salt or as an ingredient in salads, though the coarser, outer stalks are often used to flavor soups and stews or boiled and served as a vegetable.

#### CELERY, COMMERCIAL PRODUCTION, U.S.

4-Year Average, 1927-30

Division	Acreage	Production (Crates)	% of Tot. Prod.
UNITED STATES .....	28,278	8,483,000	100.0
LEADING STATES:			
Florida .....	5,722	2,286,000	26.9
California .....	9,005	2,241,000	26.4
New York .....	4,915	1,672,000	19.7
Michigan .....	4,233	1,074,000	12.7
New Jersey .....	950	282,000	3.3
Colorado .....	933	256,000	3.0

Although still grown in home gardens to some extent, the labor involved, the frequency of failure, and the constant, available commercial supply in markets and stores have made general celery growing less popular than formerly. Commercial plantations are mostly on naturally wet but artificially drained peaty areas where a constant supply of water is easily maintained, when necessary, by closing the drains and allowing the water to rise in the soil. Seed is sown in hotbeds for the early crop and in the open for late celery. The seedlings are transplanted once or twice before being planted in permanent quarters. In the new celery culture the rows are made 12 in. or less apart so the plants will blanch themselves without being hilled or boarded. This method is more popular for early than for late celery. Under the still popular older method the late crop is dug and the plants set close together in moist earth in cellars until blanched.

M. G. K.

**CELESTA**, a musical instrument invented by Auguste Mustel, consisting of a series of small steel bars, placed over wooden resonators, set in vibration by hammers that are actuated by levers attached to a keyboard similar to that of the pianoforte. The tone, exceedingly ethereal and flute-like, is a happy addition to the orchestral palette when used sparingly, as in Tschaikowsky's *Nut-Cracker Suite*. Its usual audible compass is from middle C upward for octaves. Commonly it is treated as a transposing instrument sounding an octave higher than the notes written, but Tschaikowsky disregards this custom in his work just mentioned, writing for it as if the celesta were a pianoforte. The tone, in fact, suggests that instrument in its acute register but is fainter, and somewhat daintier.

**CELESTIAL MECHANICS**, a branch of astronomy dealing with the motions of the heavenly bodies,

principally those of the solar system. It describes and explains such motions with the aid of Newton's law of universal attraction. Although this law can, strictly speaking, no longer be regarded as true, the changes made in it by the theory of relativity are so trifling that they can be ignored in all but a few highly precise applications. The basis of celestial mechanics is the so-called two-body problem, which considers two bodies mutually attracting each other with a force proportional to the product of their masses and inversely proportional to the square of their distances. If the heavier of these two bodies is assumed to be at rest, the other body will describe an ORBIT around it, which, though always a conic section, depends in shape and size upon the amount and the direction of the velocity of this second body.

The general problem of determining the motions of three or more bodies subject only to their mutual attraction has not yet been solved. Fortunately, however, the cases occurring in practice invariably contain one dominant body, the sun, and two or more bodies of less importance, the planets or comets. In such a case the motion of each of these lesser bodies around the dominant one is computed as if only those two bodies existed, while the influence of the attractions of the remaining secondary bodies is then taken into account by effecting small corrections to the original orbit.

**CELESTIAL SPHERE**, pictured in our imagination as the sphere of indefinitely large dimensions against which we see all objects in the sky projected. Whenever, for the sake of convenience, a representation in finite size is made, all objects marked upon it merely indicate the directions in which they are seen from the earth.

**CELESTINE V** (1215-96), Pope from July 5-Dec. 13, 1294, was born in Naples in 1215. He became a Benedictine, living the life of a hermit for many years during which time he founded the Celestine Order. Shortly after he was elected Pope he decreed that any pope might abdicate at will, of which privilege he availed himself a few months after taking office. His successor, Boniface VIII, who promoted the abdication, had him imprisoned until his death, May 19, 1296. He was canonized by Clement V. in 1313.

**CELESTINES**, two congregations bearing the name of Pope St. Celestine V (Pietro di Murrone). Members of the first, a branch of the Benedictine Order, were called Hermits of St. Damian and Hermits of Murrone. The order received the approbation of Urban IV in 1264, and before the close of the century had 36 monasteries and 600 members, but declined after the Reformation. The second group, Franciscan Celestines, or Poor Hermits of the Lord Celestine, were spirituals of the strictest observance. They obtained the sanction of Celestine V in 1294, but papal favor was withdrawn by Boniface VIII, and later, in 1317, the congregation was suppressed by John XXII.

**CELESTITE**, an ORE of strontium and a source of strontium salts. The name refers to the faint shade

of blue often observed, although the mineral frequently is white to reddish. It is transparent to opaque, and is found in orthorhombic crystals and in fibrous, granular, concretionary and earthy forms. Celestite commonly occurs in crevices in limestone and is associated with GYPSUM and sulphur in beds of chemical sediments, rarely in veins. It is the sulphate of strontium.

It occurs in Michigan, Arizona, Texas, California and near Bristol, England. Strontium is used in sugar-refining, in the manufacture of fireworks, such as red flares, and in medicines. *See also* ORE DEPOSITS; STRONTIANITE; ORTHORHOMBIC SYSTEM.

**CELIBACY**, the state of being unmarried, whether the celibate be secular or religious. As a secular condition it has sometimes included widowhood, and among hand-cultured peoples has been considered a matter for reproach, as putting the individual more or less outside the social pale. It has sometimes been discouraged by the state for practical reasons; Augustus instituted legislation which disabled celibates from inheriting except from relatives within six degrees. Modern civilization is more favorable to the celibate from a social point of view, but the state often discriminates in the matter of taxation.

As a religious condition among primitive peoples, celibacy seems to rest upon the belief that the gods can be propitiated by abstinence from marriage. To this end it has been enforced upon the ministers of various Eastern religions. A notable Western instance is that of the Roman vestals. Among the Jews barrenness was regarded as a disgrace for priests as well as for laymen, although on solemn occasions the Law demanded continence in officiating priests. Two centuries before Christ, however, the sect of the Essenes arose, embracing celibacy and other ascetic practices. To this sect John the Baptist is sometimes said to have belonged, and the words of Jesus commending celibacy to "those who are able to receive it" have been taken as expressing sympathy with the Essenes. Among early Christians marriage was permitted to priests, although some elected to devote themselves wholly to God. Such discipline as was enforced aimed rather at the stamping out of pagan polygamy; a bishop, elder or deacon must be "the husband of one wife." The morality of second marriages was questioned and early in the 3rd century the ancient levitical rule that priests should marry only virgins was revived. According to the so-called Apostolical Constitutions of the early 4th century, only deacons and subdeacons might marry after ordination, though priests and bishops already married were allowed to retain their wives. Meanwhile the rapid progress of monasticism in Egypt and Syria among ardent converts from a corrupt paganism had enormously increased the prestige of celibacy. In the 4th century the life of the highly ascetic St. Anthony was being read throughout the Roman Empire and, under the influence of St. Jerome, monasticism was introduced into the highest Roman society. (*See* MONASTICISM.) At about the same time the increased value of church

property, consequent upon the conversion of the Empire to Christianity, gave rise to concern lest the wealth of the church be used to perpetuate a hereditary caste of priests. Under these influences the papacy required strict celibacy of all bishops, priests and deacons, beginning with the *Decretal of Siricius* in 385. Leo the Great (d. 461) and Gregory the Great (d. 604) were active in enforcing the rule and extended it to subdeacons.

During the early medieval period resistance to the law of celibacy was general throughout Europe, and the clergy openly married in many places, notably, in northern and southern Italy, England and France. But toward the end of the 11th century the tendency of the clergy to develop into a self-perpetuating caste aroused fresh indignation. Through the influence of St. Peter Damiani (988-1073) upon several popes, and upon Hildebrand, afterward Gregory VII, the so-called "concubinary priests" were forbidden to say Mass in 1073, and various disciplinary measures were passed. The preaching friars of the 12th and 13th centuries, Franciscans and Dominicans, revived the spirit of monasticism and with it the prestige of celibacy. Open marriages of the clergy ceased. Nevertheless in the 14th century a new decadence set in and the Reformation was the occasion of a still further collapse of discipline even among those priests who remained loyal to Rome. So serious was the situation that at the Council of Trent (1545-63), the Emperor Ferdinand and other Catholic sovereigns pleaded for permissive marriage of the clerics. The Council, however, pronounced anathemas on all who should dare assert that clerks in Holy Orders, monks or nuns could contract marriage. Seminaries for the education of the priesthood were now founded or made to function properly, and effective reforms in the old religious orders combined with the foundation of new ones to revive the prestige of celibacy and encourage its observance. At present there seems to be little question that the rule of celibacy is accepted universally by the secular clergy and that it is loyally observed. The morale of the celibate religious orders has perhaps never been higher than it is at the present time.

The Christian churches of the East, known as Orthodox or Greek, have not at any time required celibacy of their parish priests. Before receiving orders a candidate is called upon to decide whether he will marry or enter a monastery. He cannot marry after receiving orders, nor can a married priest be ordained a bishop. The bishops consequently are selected from among the monks. Those churches which acknowledge the authority of the Pope but retain Oriental rites, the so-called Uniat churches, do not forbid their clergy to marry, but there has been of late years a tendency toward conformity with the Latin Church in this particular. Within the Anglican Communion a similar tendency has been at work since the beginning of the Oxford Movement about 1833. It has been accompanied by a revival of the spirit of monasticism and the founding of numerous orders

for men and women. The Old Catholic Church, however, has had a married clergy since 1875.

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**CELL**, in biology, a term most simply defined in present day usage as a minute mass of living substance containing a nucleus. By Cell Theory is meant the interpretation that all living things, animals and plants, are composed of cells which are the ultimate units of functions as well as of structures.

The name cell is, however, a misnomer which reflects the history of the concept. The term had been in common use since 1665 when Robert Hooke applied it to the compartments in cork. The cellulose cell walls are very striking in plants, hence it was that when the Cell Theory was formulated by a botanist, Schleiden (1838) and a zoologist (anatomist) Schwann (1839), the term with its implication of a compartment plan of organization became an integral part of the generalization. It took the observations of several workers and 22 years for the transfer of emphasis from the container to the thing contained and a recognition that the living substance, protoplasm, which Schleiden in the plant cell had termed slime, was the essential thing.

During this early period the universal presence of the nucleus became more and more definitely recognized. However, not until 1861 was the definition of a cell as formulated in the first paragraph fully established (Max Schultze). Due to the complex character of the changes which cells undergo when they divide to form new cells, 20 more years passed before it was fully clear that all cells arise from pre-existing cells and also that the nucleus is formed by division of a preexisting nucleus. Since that time knowledge of the cell has markedly increased and has largely emphasized the importance of the nucleus.

In structure a typical cell consists of nucleus and cell body, known as cytoplasm. The nucleus, save at times of division, possesses a superficial condensation or nuclear membrane. The cell body may or may not be bounded by a distinct cell-membrane although apparently always a superficial condensation of the cytoplasm is present.

The characteristic material of the nucleus possesses a more or less marked affinity for basic stains and hence is termed chromatin. When cells divide the chromatin is very evenly distributed between the two daughter cells, as will be described presently. Not infrequently one or more nucleoli, usually spherical, are present. These typically take an acid stain. At times of nuclear division they disappear to reappear in the daughter nuclei. Their significance is uncertain.

The nucleus is quite uniform in appearance in different kinds of cells but the cytoplasm varies enormously in appearance. In animal cells the following are usually present. Near the nucleus are two centrioles often enclosed in denser cytoplasm, the centro-

some. Surrounding it usually as a network the Golgi apparatus is demonstrable; it is of unknown significance. Special rods, threads or granules termed chondriosomes appear to be always present. They are clearly significant in the cell activities.

**Cell Division.** Cells usually arise by division of preexisting cells; nuclei apparently always by division of other nuclei and by a complicated procedure termed mitosis. This is divisible into three or four phases. In the first, prophase, the chromatin material becomes concentrated as a number of threads, the chromosomes, characteristic in form and constant in number for each species. Sooner or later the chromosomes are doubled through longitudinal splitting. The nuclear membrane dissolves and the chromosomes are arranged upon the division spindle which has in the meantime appeared between the centrioles as they move toward opposite sides of the cell. This, the metaphase, insensibly merges into the anaphase as the groups of daughter chromosomes move toward the two poles of the spindle there to be reconstituted (telophase) as the nuclei of the daughter cells which are formed by an accompanying division of the cell body.

Variants in detail are common in different animals and plants, but none affect the fundamental significance of the process as an equal division of the chromatin material of the mother cell between the daughter nuclei. This ensures a continuity of all parts of the chromatin from cell generation to cell generation and a uniformity of nuclear substance throughout the body. The process of mitotic division indicates the great importance of the nucleus and it is particularly in relation to theories of HEREDITY that the phenomena have been studied. Rarely, nuclei may divide by simple constriction (amitosis), and still more rarely, if at all, is the direct nuclear division followed by cell division. Amitosis occurs only in cells of no genetic significance.

From the physiologic side also the importance of the nucleus is indicated. The utilization of foodstuffs and constructive metabolism, known as anabolism, are clearly dependent upon the presence of the nucleus. If a cell is divided into nucleated and non-nucleated halves only the nucleated portion will continue to live. There is also good evidence that the utilization of oxygen, so essential for metabolism and life, depends upon the nucleus. The nucleus may thus be termed the metabolic center and the cell a metabolic or vital unit. The cell is therefore a means to an end rather than an end in itself. It at once becomes comprehensible that organisms or parts of organisms may exist in which nuclear division may not be followed by cell division. Never, however, is there found any extensive mass of protoplasm without the presence of nuclear material. It is in the cytoplasm that the characteristic activities of cells take place, hence its structure directly expresses the special form of activity there existent.

B. F. K.

**CELL, VOLTAIC** or primary, an apparatus which generates electric current by chemical reactions; it

consists of two conductors of dissimilar materials immersed in an electrolyte (*see* ELECTROLYSIS) or in two electrolytes which are in contact with each other. Such an arrangement maintains a difference of potential between the two conductors because the contact potential between one of them and the electrolyte differs from that between the other and the electrolyte. When such a cell is connected into an electric circuit, it supplies the electromotive force and the energy for maintaining an electric current.

When a solid conductor is immersed in an electrolyte, the forces of adhesion between it and the electrolyte decrease the surface tension of the conductor, enabling the  $+$  Ions of such metals as zinc and cadmium, in which the forces of cohesion are comparatively small, to pass out of the metal into the solution. The departure of the  $+$  ions continues only until the difference of potential established between the metal and the electrolyte can, in conjunction with the OSMOTIC PRESSURE, prevent a further outflow of the ions. This difference of potential for zinc immersed in a normal solution of  $\text{ZnSO}_4$  is 0.48 volts.

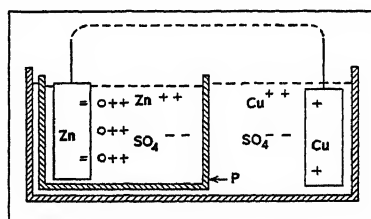


DIAGRAM OF DANIELL CELL

In the case of such metals as copper, where the forces of cohesion between the atoms are comparatively large, the electrolyte does not diminish the cohesion sufficiently for the metal ions to pass into the solution. The  $+$  ions of the electrolyte have a greater affinity for the immersed metal than the negative ions, and they pass out of the solution, charging the immersed metal positively until its acquired potential prevents further action. The difference of potential established in this manner between copper and a normal solution of  $\text{CuSO}_4$  is 0.62 volts.

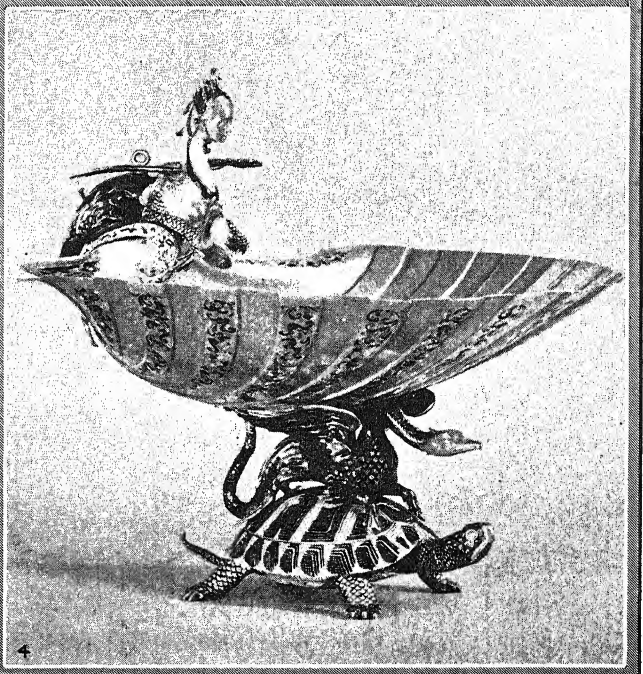
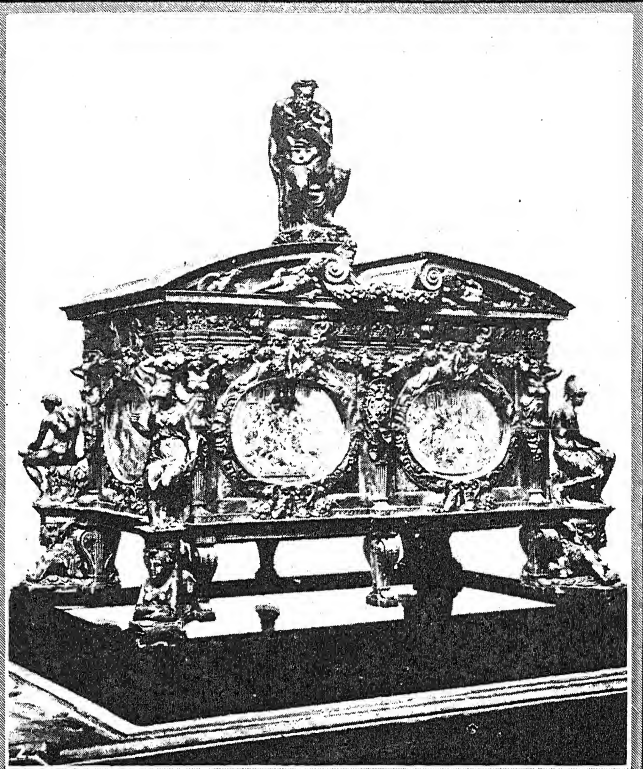
The total difference of potential at  $25^\circ \text{C}$ . between the zinc and the copper plates immersed in normal solutions of  $\text{ZnSO}_4$  and  $\text{CuSO}_4$  respectively is 1.10 volts when the solutions are in contact.

The *Daniell Cell* is composed of these materials, except that other than a normal solution of the salts are employed. The electrolytes are brought into contact either by immersing a porous cup containing the  $\text{ZnSO}_4$  solution into the copper sulphate solution, as shown in the figure, or by floating the lighter  $\text{ZnSO}_4$  on the heavier  $\text{CuSO}_4$  solution.

When the zinc and copper plates of the Daniell Cell are connected by means of a wire outside of the electrolytes as shown by the broken line, ELECTRONS flow through it from the lower potential at the zinc plate to the higher potential at the copper plate. This transfer disturbs the equilibrium at each of the plates,



## CELLINI



4. COURTESY METROPOLITAN MUSEUM OF ART

### BENVENUTO CELLINI, MASTER OF THE RENAISSANCE ARTS

1. Ganymede, a bronze figure in the National Museum at Florence. 2. Casket attributed to Cellini in the National Museum at Naples. 3. Gold and enamel salt cellar with figures representing the Sea and Earth, wrought for Francis I. "The Sea was a man, and in his hand I placed a ship

... to hold a quantity of salt. . . . The Earth I fashioned like a woman. . . . In her left hand I placed a little temple of Ionic architecture, . . . to contain the pepper," Cellini's *Autobiography*. 4. The famous Rospigliosi Cup of gold and enamel, one of Cellini's finest pieces.

developed by John W. Hyatt of Newark, N.J., in 1869. The name "Celluloid" is a registered trade mark in the United States. Other names under which these plastics are marketed are: Fiberloid, Pyralin, Viscoloid, etc.

The peculiar characteristic of compounds of this type is that, while tough and hard under ordinary conditions, they become soft and plastic under the influence of heat and pressure. This thermo-plastic property enables them to be molded and formed into the wide variety of articles in which they are sold.

In the manufacture, nitrocellulose of a low degree of nitration is mixed with approximately 40% of its weight of camphor. Sufficient alcohol is added to allow the mixture to be worked to a thick, clear dough. Pigments and dyes are often incorporated to obtain a wide variety of color effects. The alcohol is removed by heat and vacuum and the residual plastic either extruded from heated hydraulic presses in the form of rods and tubes, or cast under pressure into blocks or forms. These general forms are further worked into the desired shapes.

The uses for celluloid are extensive and varied. Imitation ivory, tortoise shell and mother-of-pearl, in such forms as toilet sets, are well known. Other specialized uses of more recent development range from bottles and tubes for special pharmaceutical purposes to the transparent sheets used in the lamination of safety or shatter-proof glass. *See also* NITROCELLULOSE; PYROXYLIN; PLASTICS, SYNTHETIC. W. M. B.

**CELLULOSE, INDUSTRIAL USES OF.** *See* CELLULOSE PRODUCTS.

**CELLULOSE ACETATE**, a product prepared from purified and bleached cotton or linters by esterification with a mixture of acetic acid and anhydride, in the presence of a so-called catalyst, such as sulphuric acid. The properties of the ester, such as solubility, elasticity and strength, vary widely with the conditions of esterification, and temperature is a very important factor. The primary tri-acetate is soluble in chloroform, but insoluble in acetone. The secondary acetate, which is soluble in acetone and most widely used in industry, usually consists of a mixture of di- and tri-acetates and is formed by hydrolysis of the primary acetate.

The interest in and use of cellulose acetate (Schuetzenberger, 1865) has increased very rapidly since the World War. The principal uses are in the manufacture of acetate silk, lacquers, aeroplane dopes, fire-proof films, synthetic plastics and celluloid-like products, "ultra-violet" and "safety" glasses, etc. The world production of acetate silk in 1928 was 25,100,000 lbs. (U.S. 5,000,000 lbs.); 1929, 25,168,000 lbs. (U.S. 7,000,000 lbs.); and 1930, 28,700,000 lbs. (U.S. 10,000,000 lbs.). Due to the superior properties of acetate silk, interest in this type of synthetic yarn is increasing more rapidly than in any other type. The Celanese Companies are by far the largest producers in both America and the world. Acetate silk is known under the brand names of Celanese, Rhodiaseta, Chacelon, Acele, Seraceta, Aceta, Setilose, and Setyl.

*See* CELLULOSE ESTERS; LACQUERS; PLASTICS; YARNS, SYNTHETIC. C. E. M.

**CELLULOSE ESTERS.** The first cellulose ester recognized was the nitrate (Braconnot, 1833) and it still remains the most important in quantity production and variety of uses. As the cellulose unit (anhydro-glucose,  $C_6H_{10}O_5$ ) contains three hydroxyl groups, only the mono-, di-, and tri-esters are possible. Purified cotton or linters are almost universally used as the source of cellulose. The tri-esters are prepared by direct esterification, with the aid of a so-called catalyst, and the lower esters are obtained by the hydrolysis of the tri-ester. The properties of the esters vary widely with slight differences in the methods or conditions of esterification. Aside from the nitrates and acetates, the simpler aliphatic acid esters are of most interest. The formates and propionates are not used commercially and the butyrate appears to be more suitable for the manufacture of lacquers and plastics than yarns. Most of the actual and proposed uses of the esters are along the same lines as those of the nitrates and acetates. Mixed esters, such as the monoacetate-dinitrate, sulphate-acetate, laurate-stearate, etc., are known, but have not been used commercially. Immunized cotton is an ester of the sulpho-aromatic type. Cellulose esters are used in the manufacture of synthetic yarns, lacquers, plastics, celluloid and other plastics, films, explosives, smokeless powder, etc. C. E. M.

**CELLULOSE PRODUCTS.** Aside from the direct manufacture of cotton textiles, the principal industrial uses of cellulose are in the production of paper, rayon, explosives, lacquers, artificial leather, celluloid, and films. **PAPER** is made largely from wood cellulose. In order to free the cellulose fibers from lignin and other encrusting materials, the wood is cooked with various chemicals, the nature of which depends upon the wood used and the kind of "pulp" desired. In the alkaline pulping processes, the wood is cooked with caustic soda alone (soda process) or admixed with sodium sulphide (sulphate process). The sulphite processes involve the use of calcium-magnesium bisulphite (acid process) or sodium sulphite (neutral process).

Rayon is made from either wood pulp or cotton linters. Both types of cellulose require careful preliminary purification, involving cooking with caustic soda and bleaching. In the manufacture of rayon it is necessary first to prepare a solution of the cellulose. This solution is forced through fine orifices and coagulated to obtain filaments. There are four principal rayon processes in use: (1) The viscose process, in which the cellulose is treated with strong caustic soda, followed by carbon bisulphide to produce the soluble cellulose xanthogenate. The latter is regenerated to a nearly pure cellulose filament in an acid coagulating bath. (2) The acetate process comprises conversion of the cellulose to the acetic acid ester. Evaporation of the volatile organic solvent during spinning leaves a filament of cellulose acetate. (3) In the cuprammonium process, the cellulose is dissolved in an am-

moniacal solution of cupric oxide, the copper being dissolved from the filament in an acid bath. (4) The oldest rayon process, the nitrate, makes use of a solution of cellulose nitrate. The finished rayon consists of regenerated cellulose, the nitrate radical being removed on account of the explosive nature of cellulose nitrate.

**CELLULOID**, imitation leather (*see* LEATHER, IMITATION), and certain EXPLOSIVES and LACQUERS consist essentially of cellulose nitrates of varying degrees of nitration, solubility, and viscosity. Nitrates containing 13.3 to 13.7% of nitrogen are usually insoluble in alcohol-ether mixture and are known as GUN COTTON. The nitrates with about 12.0% of nitrogen, the soluble pyroxylin, are used extensively in the arts. In the presence of camphor, PYROXYLIN becomes plastic on heating and can be molded into a wide variety of celluloid articles. Imitation leather is prepared by coating a fabric with a "dope" consisting essentially of pyroxylin and castor oil in a volatile solvent. A series of lacquers for exterior and interior use have been developed. Automobile lacquers contain a low viscosity cellulose nitrate, resin, and a plasticizer. Lacquers for airplanes are usually made from cellulose acetate.

Photographic films are made from pyroxylin and to a limited extent from CELLULOSE ACETATE. On account of its low fire hazard, cellulose acetate would be used much more extensively for photographic films if a satisfactory plasticizer were available to overcome the objectionable brittleness. Within recent years there has been an extensive development in the use of thin transparent cellulose sheets as wrappers and containers. A sheet of the type of cellophane is made from VISCOSÉ in a manner similar to rayon, the essential difference being that the viscose solution is forced from a hopper having a long, narrow slit in order to obtain a film. A similar product is made also to a limited extent from cellulose acetate. *See also* CUPRAMMONIUM SILK; PLASTICS; YARNS, SYNTHETIC.

A. W. S.

**CELOM**, the cavity in the body formed by the splitting of the somatic or external and the splanchnic or internal layers of the mesodermal germ layer. (*See* EMBRYOLOGY.) In the lowest vertebrates excretory substances drain into the celom, which in turn opens to the exterior. In higher forms, with the development of the mesonephros and kidney, the celom is closed. The peritoneal cavity (*see* ABDOMEN), pleura, and pericardium are developed as spaces partitioned off from the general celom.

**CELOTEX.** *See* FIBER BOARDS.

**CELSIUS, ANDERS** (1701-44), Swedish astronomer and physicist, was born at Uppsala, Nov. 27, 1701. In 1736 with Maupertius he measured the arc of a meridian. In 1740 he founded and became director of the Uppsala Observatory. In 1742 he turned to problems of temperature and developed the Celsius scale thermometer now widely in use (known as Celsius or Centigrade), based upon a division of 100 points between the boiling and freez-

ing temperatures of water at standard pressure. He died at Uppsala, Apr. 25, 1744.

**CELSUS, AURELIUS CORNELIUS**, Latin writer, who lived in the reign of Tiberius Caesar. While not a physician, he compiled and translated encyclopaedia treatises on medicine, and rendered medical assistance to people who asked for it. His work, entitled *De Re Medicina*, was one of the first medical books to be printed in 1478, and eventually passed through more editions than any other medical text of the time, including those of Hippocrates and Galen. Celsus wrote philosophically and is credited with being the first important writer on medical history.

**CELTIC LANGUAGE**, an independent branch of the *centum*-group of the INDO-EUROPEAN linguistic family, so closely akin to Italic and Ligurian that many scholars postulate an early period of Italo-Celtic unity. It falls into three main groups: the extinct GAULISH; Brythonic or British—Welsh, Breton and the extinct Cornish; and Goidelic or Irish—Irish and Manx (*see also* separate articles on these subjects). Brythonic with Gaulish is frequently called the *p*-group and Goidelic the *q*-group because of their respective correspondences for the Indo-European surd labialized velar, as hypothetical Indo-European \**q<sup>u</sup>is* "who," Irish *cia*, Breton *piou*. The group is further characterized, except in Gaulish and Ogham Irish, at least in script, by "aspiration" or "lenition" of initial surds, sonants, liquids, nasals, and *s* following a word originally ending in a vowel, e.g., Irish *m* becomes *mh*, pronounced *v*; by "infection," in which a vowel is affected by an original following vowel which later was lost, e.g., Old Irish *ech*, "horse," from hypothetical \**equos*, but genitive *eich* from \**equi*; by the divergent effect exercised on consonants by "broad" and "slender" vowels: *a*, *o*, *u* and *e*, *i* respectively; and everywhere by loss of Indo-European *p*, e.g., Latin *pater*, Irish *athir*, "father." L. H. G.

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**CELTIC LITERATURE.** By Celtic literature is to be understood here compositions couched in a Celtic language. These languages it is customary to classify in two general groups, the one denominated Continental, the other, Insular, Celtic. The former, commonly called Gaulish, disappeared in the 5th century A.D. Insular Celtic is divided linguistically into Gaelic, of which there are three varieties: Irish, Scottish and Manx; and Brythonic, likewise of three varieties: Welsh, Cornish and Breton. Of the literature of the Gauls, which consisted of historical poems and war songs, nothing is preserved, since it was forbidden by the Druids, the learned class, to consign their lore to writing. Of the literatures in Insular Celtic, that in Irish is by far the most important because of its age, extent and quantity.

**Irish.** The earliest monuments of Irish Gaelic are thousands of glosses dating from the 8th and 9th

centuries, but, although of the greatest importance for the structure of Irish grammar, they possess scarcely any literary value. Irish literature is, after the literatures of Greece and Rome, the most ancient in Europe; in other words, it is the oldest literature of any of the nations north of the Alps. Although the bulk of this material is preserved in manuscripts which do not go further back than the 12th century, the texts they transcribe often antedate them by several centuries. Some of them are purely pagan. Foremost among these are hundreds of epic tales which, for richness and originality, have no equal in western Europe. Chronologically and according to subject, they fall into three great cycles. The oldest is the Mythological Cycle and relates chiefly to the gods of the ancient Irish and to the earliest inhabitants and invaders of Ireland, their migrations, settlements and conflicts. Next in time, and perhaps greater in importance, is the Heroic Cycle. It consists of a score or more of stories which narrate events supposed to have taken place shortly before the Christian era. Here the background is undoubtedly historical. The core is the rivalry of Ulster, led by King Conchobor (Conor) with the warriors of the Red Branch, against Connacht and the rest of Ireland, led by Medb and her consort, Ailill. The tales are in prose, sometimes interspersed with verse, and bring into view a civilization similar to that depicted by Homer.

The central and most magnificent episode of the group is known as *The Cattle-Raid of Cooley* and is taken up almost entirely with the exploits of the hero Cuchula, "the Irish Achilles." More or less closely related to this cycle are a multitude of smaller epic tales of the most diverse character. The third of these cycles deals with Finn Mac Cumhaill, his son, Ossian, and the other chieftains of the Fianna (Fenians), a band of soldiers, hunters and poets who flourished in Ireland in the 2nd and 3rd centuries. This cycle is mostly in verse. Connected with it are a large number of romantic tales which are still alive in Gaelic-speaking Ireland and Scotland and were converted to his use by James Macpherson in his celebrated, so-called translations of the poems of OSSIAN. To another but smaller saga group belong some half dozen "Navigations" or "Sea-Voyages" in search of the Land of Promise, such as the *Voyage of Bran*, which is all pagan, and the *Voyage of Mael Duin*. But the most famous example of this class is the *Voyage of Saint Brendan*, which enjoyed unparalleled popularity all over Europe throughout the Middle Ages and was even one of the contributory causes of the discovery of the New World. There are, besides, a vast number of minor tales of adventure, either of native origin or with the characters and scenes borrowed from classical antiquity, from Scandinavia and the Orient. The rich Irish literature of vision was the ultimate germ of Dante's *Divine Comedy*, and as for the Arthurian romances and the Tristram and Grail sagas, these are in the last analysis either of Celtic origin or shot through with Celtic motives.

The earliest Irish poetry was in the hands of a class of professional poets called *fili*, who were not only official and court poets but also story-tellers, historians and antiquaries as well. The poems of many of them have been preserved. By the 13th century, however, the *fili* were superseded by the bards whose poetry is of a more popular character. A direct and intimate love of nature first finds expression in Old Irish lyric poetry. Early Irish literature is rich in annals and historical works of all kinds, in treatises on law, topography, chronology and genealogy, in the greatest profusion, in compilations on astronomy, medicine, pharmacy and grammar, in religious works of the greatest variety, such as lives of saints, hymns, psalters, and panegyrics, elegies, prophecies and collections of maxims and proverbs.

Modern Irish literature begins with the works of Geoffrey Keating, who died in 1650. From that time to the first quarter of the 19th century there was a galaxy of poets, chiefly from the south of Ireland, whose work was either on political and religious subjects or in lighter vein and made up of love and drinking songs. With the revival of the national sentiment in Ireland there has grown up a renaissance in all forms of Irish literature.

**Scottish.** Inasmuch as both Scotland and the Isle of Man were colonized from Ireland, their Gaelic literature, as might be expected, at least in its earlier stages, is common to the mother country. The Fenian or Ossianic cycle was especially at home in Scotland. It was not until the 17th century that Scotland began to produce works of a more original character. These works are mostly ballads, love songs and patriotic hymns. The prose consists mostly of popular tales, sayings and proverbs. Scottish Gaelic folklore is one of the richest in Europe.

**Manx.** Manx literature is almost exclusively of a religious character, and is composed of translations of the Scripture, sermons and, above all, of carvels or carols which are still sung on Christmas Eve in churches in the Isle of Man.

**Welsh.** The most ancient Welsh texts have to do with traditions concerning the earliest inhabitants of Britain and relate legends of a more or less mythological nature. A few of the oldest tales seem to contain elements common to both Britain and Ireland. Although some of the lyric poetry has been attributed to poets of the 5th century, the oldest literary texts were not composed before the 12th century. As in Ireland, many of the scattered legends of the race were brought together in great vellum codices dating from the 12th to the 14th century. In both countries special attention was given to the codification and elucidation of the native laws; these law tracts are of the greatest value because they exhibit the life, manners and social condition of the inhabitants of Britain and Ireland before the Saxon and Viking invasions, and are unaffected by foreign influence. The most famous Welsh prose romances are in a collection of 11 tales known as the *Mabinogion*; but this title strictly belongs only to the four oldest



which deal with persons and events of remote antiquity, while most of the others refer to the Arthurian cycle. They are preserved in manuscripts of the 14th century but were redated much earlier.

Throughout the Middle Ages Wales was conspicuous for the number of her poets and the quantity and excellence of their productions. As in Ireland, there were schools of poetry and court poets, like the Irish *filii*, and bards, all arranged in a carefully graded hierarchy. The learned poets were greatly hampered by the strict laws of versification required in the professional schools. Their poetry was for the most part of a heroic or elegiac nature, and covered a wide range of subjects. The greatest of all the Welsh poets, and in some respects the greatest poet of the entire Middle Ages, was Dafydd ab Gwilym who lived at the end of the 14th century and was thus a contemporary of CHAUCER. He is especially famous for his love songs and his descriptions of nature. Another celebrated Welsh poet was Goronwy Owen who died in 1769 in America. At all times the Welsh have had a strong penchant for didactic and religious topics, and this is the prevailing note of their literature from the 16th century to the present day. The masterpiece of modern Welsh prose is Ellis Wynne's *Visions of the Bard Sleep* 1703, a satire on the follies of the world. During the 19th and 20th centuries more has been printed in Welsh than in any other Celtic language.

**Cornish.** There is no literature worthy of the name before the Middle Cornish period, and this is almost entirely of religious inspiration, viz., a long poem on the Passion of Christ, 15th century, three miracle plays or dramas in verse on the biblical story from the Creation to the death of Pilate, and a metrical life of Meriasek. Although very little of literary worth has been preserved of Cornish literature, the world is indebted to Cornwall as one of the sources, and not the least important, of the Arthurian romances. The Cornish language ceased to be spoken in the 18th century.

**Breton.** The earliest literary texts in Armorican Breton date from the end of the 15th century and are, with a few exceptions, on religious subjects. More than in the other Celtic lands, with the possible exception of Cornwall, the theater plays an important part in the history of Breton literature. Most of these mystery plays were adapted from the French and date from the end of the 18th and the beginning of the 19th century. In modern times Breton literature is extraordinarily rich in ballads, popular songs, traditions, legends of the sea, of death and of the *pardons*. The most famous collection of the historical ballads, known as *Barzaz Breiz*, or "Popular Songs of Brittany," was published in 1839. Of more popular origin are the *gwerziou* "plays" and the *Soniou* "songs," short ballads or village tales in verse of a very dramatic quality. J. Du.

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**CELTIIUM.** See HAFNIUM.

**CEMENTATION**, a process of introducing carbon into iron by heating it in contact with carbonaceous matter at a temperature below its melting point. The iron is usually packed in powdered charcoal and heated in air-tight firebrick chambers. The proper temperature is reached in three to four days and is maintained for about seven days. If wrought iron is employed the reaction between the slag which it contains and the carbon produces blisters on the surface, the resulting product being called BLISTER STEEL. The amount of carbon induced by cementation varies from .5-1.5% depending on the temperature and length of heating.

**CEMENT PLASTERS.** See GYPSUM PLASTER; also PLASTER WORK.

**CEMENTS** used in structural work may be divided into two main classes: 1. *Non-hydraulic Cements* which will not set or harden under water, and comprise GYPSUM PLASTERS and Common LIME, and 2. *Hydraulic Cements* which will harden in either water or air, and comprise:

**Hydraulic Lime** is made by burning clayey, or argillaceous; or sandy, or silicious, LIMESTONE. When showered with water, the product slakes without sensibly increasing in volume and possesses hydraulic properties.

**Lime Cement** is a by-product produced by grinding the lumps of underburned and overburned hydraulic lime which do not slake. It is not manufactured in the U.S. A number of hydraulic limes and "grappier" or lime cements are marketed as "non-staining cements"—that is, they do not stain MASONRY. For this reason a considerable amount of this material is annually imported from Europe for decorative architectural purposes.

**Puzzolan or Slag Cement** is made by incorporating hydrated lime with a silicious material, such as granulated blast-furnace SLAG, of suitable fineness and chemical composition. Although this possesses hydraulic properties, it should not be confused with *slag Portland cement* which is produced by calcining finely divided slag and lime in a KILN and pulverizing the resulting "clinker." Puzzolan cement is not as strong nor as reliable as either natural or Portland cement and should be used only in unimportant structures or in unexposed work, such as FOUNDATIONS, where weight and bulk are more important than strength.

**Portland Cement** is made by finely pulverizing the "clinker" produced by burning a definite artificial mixture of silicious (containing *Silica*) argillaceous (containing *Alumina*) and calcareous (containing *Lime*) materials to a point somewhat beyond where they begin to fuse or melt. The product is one that does not slake and possesses strong hydraulic properties. The essential components of Portland cement—silica, alumina and lime—are obtained from



many sources, but the proportions used of the raw materials are always such that the chemical composition of the different Portland cements is constant within narrow limits.

The percentages of the principal components are about as follows: Silica, or  $\text{SiO}_2$ , 19-25%, alumina, or  $\text{Al}_2\text{O}_3$ , 5-9%, iron oxide, or  $\text{Fe}_2\text{O}_3$ , 2-4%, lime or  $\text{CaO}$ , 60-64% and magnesia or  $\text{MgO}$ , 1.0-2.5%.

Small amounts of alkalis,  $\text{K}_2\text{O}$  and  $\text{Na}_2\text{O}$ , and sulphur trioxide,  $\text{SO}_3$ , are also present. Magnesia,  $\text{MgO}$ , is considered by some as an impurity, while other investigators claim it is equivalent to lime,  $\text{CaO}$ , in its action. Alumina,  $\text{Al}_2\text{O}_3$ , and iron oxide,  $\text{Fe}_2\text{O}_3$ , do not act entirely alike but are usually considered to have the same functions.

The specific gravity of Portland cements ranges from 3.1 to 3.2 with an average of 3.15. Portland cement is by far the most important cementing material used in modern construction. It is adapted for use in CONCRETE and MORTAR for all types of structures where strength is of special importance, or in structures exposed to wear or to the elements. It should invariably be employed in re-enforced concrete construction because of its high early strength and generally uniform quality. See CEMENT TESTING; also CONCRETE TESTING.

A number of special cements employing Portland cement as a base are made by grinding in adulterating materials after CALCINATION. These adulterants include clay, slaked lime, sand, slag, natural cement, limestones, and natural puzzolanic material or *Tufa*. The action of these materials is essentially to promote combination between lime from the cement and silica from the adulterant, with formation of silicate of lime. In some cases, these silicious adulterants improve the quality of concrete made from such cements, but this result cannot be expected from all forms of adulteration.

Sand and puzzolanic materials have, perhaps, been used the most extensively and successfully of any of the adulterants, producing products known as *sand cement* and *tufa cement* respectively. These cements have been used principally on large work where freight rates are high and long wagon hauls combine to make the cost of undiluted Portland cement excessive. Cement specifications in common use are of a character to exclude any grinding in of materials after calcination, presumably on the ground that specifications permitting any adulteration would be subject to abuse, making the results uncertain.

**Quick-Hardening (alumina) Cements** have a high alumina content and are made from a fused mixture of limestone and BAUXITE. At present, the cost of alumina cement is more than that of Portland cement and, consequently, the alumina cement is used in new construction and repair work where the saving in time justifies the added cost.

Concrete, made with a quick-hardening cement, secures "initial" set (see CEMENT TESTING) in about the same time as a Portland cement and then hardens and gains strength much more rapidly. The 1-day

compressive strength of a quick-hardening cement concrete is approximately equal to the 28-day compressive strength of a Portland cement concrete of similar proportions. The 28-day compressive strength of a quick-hardening cement concrete is approximately 30% more than its 1-day strength. The quick-hardening is accompanied by a considerable development of heat, and, consequently, the concrete should be kept well sprinkled to prevent it from drying out too rapidly. This heat development is an advantage in cold-weather construction.

G. A. H.

**CEMENT TESTING**, a series of tests designed to ascertain the quality of Portland CEMENT. The specifications adopted by the AMERICAN SOCIETY FOR TESTING MATERIALS are most generally used in America and the tests outlined below are those described in these "standard" specifications.

**Fineness of Grinding.** Cement must be very finely ground, the specifications requiring that at least 78% must go through a sieve having 40,000 openings per square inch. In making this test a 50-gram sample is placed on the sieve, which is shaken in a prescribed manner for one minute and the amount passing weighed. Shaking for one minute intervals continues until not more than 0.05 gram passes. The amount remaining on the sieve is weighed and expressed as a percentage of the original weight. Many of the cements do not have over 10% retained.

**Normal Consistency Determination.** Since the amount of water used in preparing specimens for testing affects the results secured, the water used to make "pastes" for the soundness and time of setting tests, and the "mortar" in the tension tests, must be carefully measured. A paste of "normal consistency" permits a cylinder 1 centimeter in diameter and loaded to weigh 300 grams to penetrate a distance of 10 millimeters in 30 seconds. The determination of the exact amount of water necessary to produce the desired penetration is a cut-and-try process and usually is about 25% of the weight of the cement. The needle used is known as the *Vicat needle*.

**Soundness Test** is made to determine whether there is any free lime or other material in the cement which will cause a change in its shape or volume or cause a disintegration of the concrete or mortar in which it is used. A cement paste of normal consistency is prepared and a "pat" 3 inches in diameter and ½ inch in thickness at the center and tapering to a thin edge is molded on a glass plate. After remaining in a moist atmosphere for 24 hours the "pat" is heated in steam at a temperature of 98° C. to 100° C. for five hours. A "sound" cement will remain firm and hard and show no signs of distortion, cracking, checking or disintegration.

**Time of Setting** is determined by two methods which are known by the name of the needles used. The specifications define both the "initial" and the "final" set. In both, a cement paste of *normal consistency* is formed into a pat, similar to the one used in the soundness test but with a flat area on top. The pat is kept in a moist atmosphere. Two "Gill-

more needles," one 1/12 inch in diameter and loaded to weigh 1/4 pound and the other 1/24 inch in diameter and loaded to weigh 1 pound are used. When the paste is hard enough to support the first needle, initial set has taken place: final set has occurred when the second needle is supported.

When the *Vicat* needle is to be used the cement paste is pressed into a ring upon a glass plate and placed in a moist atmosphere. The *Vicat* needle in this test is one millimeter in diameter and is loaded to weigh 300 grams. If, in 30 seconds, the needle does not penetrate below a point 5 millimeters above the glass plate initial set has taken place. Final set occurs when the needle fails to penetrate.

**Tension Tests** are made to determine the strength developed by cements. One part by weight of cement is mixed with three parts by weight of standard "Ottawa sand" and with enough water to make a plastic mortar—the exact amount of water being a function of the "normal consistency." The mortar is placed in six briquet molds, packed and troweled smooth according to definite specifications. The briquets thus made have an area of one square inch at the center. Three briquets are tested at 7 days and three at 28 days to determine the pull necessary to break them. In the case of high-early-strength cements, tests are made at 1 and 3 days. E. E. B.

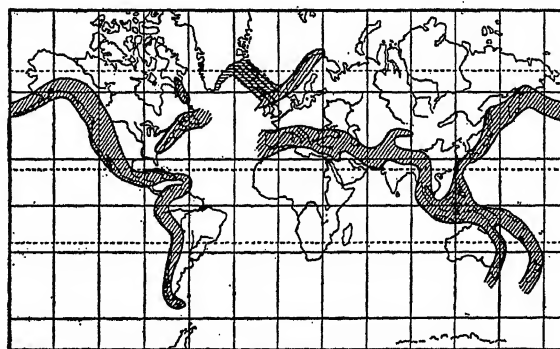
**CENCI, BEATRICE** (1577-99), a member of the famous Italian family of Cenci, was born at Rome on Feb. 6, 1577. Her father, Francesco Cenci, was a brutal man of inexplicable desires and habits. In 1595 he imprisoned Beatrice and her stepmother in a lonely castle, visiting them periodically to exercise on them his atrocious brutality. At last in 1598 Beatrice, two of her brothers and her stepmother decided to have Francesco murdered, which was done by a paid murderer. During the trial, Beatrice was tortured, but would not confess, although she did afterward. She was beheaded on Sept. 11, 1599. Her family is the subject of Shelley's *The Cenci* and several books and articles.

**CENOBITES** (coenobites), members of a monastic community as contrasted with eremites (hermits, anchorites), religious living in seclusion. The term is derived from the Greek *koinos*, common, and *bios*, life. The eremitical preceded the cenobitical form of religious life, the latter being begun by St. Pachomius about 318. See **MONASTICISM**.

**CENOZOIC ERA**, the fifth and last great division of geological history, embracing the last 60,000,000 years, or about 5% of all geological time. Its fossils record the rise to dominance of the mammalian fauna, and the development of man. The fact that the continents, and the living denizens of the earth, begin to wear a familiar aspect in the Cenozoic, does not imply any greater permanence for the lands and life of this era than of the previous ones, but merely that man's brief instant on the globe has been too short for him to record any of the changes which take place with such inconceivable slowness. A hundred million years hence the world will probably have a different aspect.

The Cenozoic is divided into the Tertiary and Quaternary periods, and these in turn are subdivided into epochs. The Tertiary into Eocene, Oligocene, Miocene and Pliocene Epochs, and the Quaternary into Pleistocene and Recent. The Quaternary is a comparatively short period, beginning with the appearance of the great Pleistocene ice sheets in Europe and North America, roughly 2,000,000 years ago, and extending to the present. Recent time dates from the disappearance of these glaciers about 20,000 years ago.

Although the oceans of previous eras had flooded North America more or less widely, in the Cenozoic only about 3% of the continent, on the average, was submerged, and that mostly along the coasts. The Gulf of Mexico extended at times, however, well up the Mississippi Valley. Elsewhere the land was elevated and many mountain ranges were built. The crustal unrest which culminated in the raising of the Rocky Mountains at the close of the **MESOZOIC ERA**, known as the Laramide Revolution, was renewed in the early Eocene. Then followed a long period of quiet up to the close of the Oligocene, when disturbances started again. In the Miocene and Pliocene, mountains were being built throughout the world, particularly in Europe, Asia, the Antilles and Central America, regions which then assumed practically their modern appearances. The Himalayas, Andes and Alps were subjected to renewed elevation at this time. In the Pleistocene came a great increase of volcanic activity which rimmed the Pacific Ocean with its so-called "circle of fire." In fact, beginning with the Middle Miocene, and extending down to the present, North America has been in the throes of a new Revolution, the Cascadian. Mountain-building and **VOLCANISM** have been active in the western part, mountains of the Pacific Coast ranges and the Rocky Moun-



FROM CHARLES SCHUCHERT, OUTLINES OF HISTORICAL GEOLOGY, JOHN WILEY & SONS

AREAS OF DOMINANT FOLDING AND UPLIFT (OBLIQUE SHADING) DURING THE CENOZOIC ERA

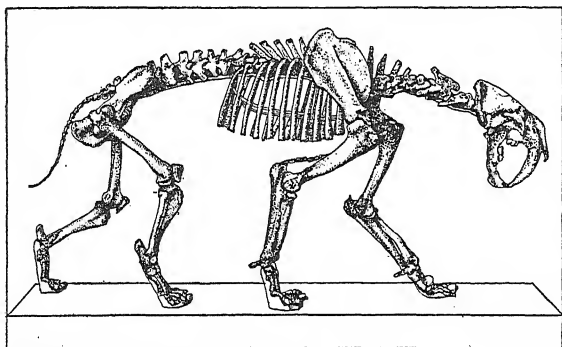
Horizontal shading, the fractured and down-sinking area of the northern Holarctic continent (Eria); northwest-southeast lines, the general direction of fractures and dikes

tain chain being folded and elevated anew. The great earthquake rift of San Francisco was formed in connection with these disturbances, and the volcanic activity resulted in covering great areas, especially in the Columbia River plateau region, with lava flows as



and by the Pliocene their rise had forced the herbivores to develop greater speed, intelligence and fighting ability.

At various times in the Tertiary there were land connections with other continents, permitting widespread migrations of animal forms. Some, such as



COURTESY AMER. MUS. OF NATURAL HISTORY

SKELETON OF GIANT SABER-TOOTHED TIGER

the horse, camel and rhinoceros, developed in North America, only to disappear on this continent after their spread to Europe. Others developed in Europe or Asia and spread to America. The mastodon, for example, after his arrival from Europe via Asia in the Miocene, lived on this continent until post-glacial time, and was possibly known to early aborigines here.

Remnants of simple Eocene types are found to-day in the rodents and the insectivores, such as the mole, hedgehog and shrew, while the tapirs are living remnants of a Miocene stage of evolution. The primates, the family to which belong monkeys, apes, and men, date back to the Eocene, the early forms being scarcely distinguishable from the early insectivores. In North America the primates became extinct at the end of the Eocene, and do not reappear until the arrival of man. The marine mammals, such as the whale, porpoise and sea lion, arose early in the Tertiary because some mammalian stocks were attracted by the ease of obtaining food in the seas, and adapted themselves to ocean life.

The non-mammalian life has not changed much, birds, reptiles, amphibians, fishes and invertebrates to-day being much as they were in the Tertiary.

The Tertiary period closes with the development of great mantles of ice covering parts of North America and Europe. At the centers from which they radiated these sheets may have been 4,000 to 8,000 feet thick in order to force their edges over so much territory, some of it mountainous. From the Canadian Rockies, Labrador and a central point west of Hudson's Bay, the glaciers spread south to Pennsylvania, Kentucky, Missouri, South Dakota, Montana, Idaho and Oregon. Soil and rocks were scraped and ground up by the ice, carried long distances and dropped, when it melted, as an ill-sorted mantle of clay, sand, gravel and boulders, called glacial drift, **BOULDER CLAY** or till. The drainage systems were profoundly

dislocated, new river channels being gouged by the ice, and old ones blocked by the dropped till. To such action is due the formation of the Great Lakes. The lands which bore this ice were warped down by its weight, and at the same time the ocean levels were lowered as the moisture evaporating from the



FROM CHARLES SCHUCHERT, OUTLINES OF HISTORICAL GEOLOGY, JOHN WILEY & SONS

#### PLEISTOCENE GLACIATION IN NORTH AMERICA

The three centers of ice accumulation are shown with arrows indicating directions of ice movement

After Anteus, with lettering and arrows added

seas was locked up in the great ice sheets. At least five times the glaciers extended out over the continents, and melted back in the face of warm, interglacial climates; even to-day the GLACIAL PERIOD lingers on in Antarctica and Greenland. The cause of these changes in climate is not understood, but must probably be sought in the interaction of a number of factors, discussed in the article on GLACIATION.

The profound modifications of environment brought about by the glacial age had its effect on the life of the Cenozoic. Many forms died out entirely, as the saber-toothed tiger and the gigantic wolves of the Tertiary, while the cold climate favored such species as the reindeer, moose, woolly mammoths and walruses. It is even possible that the evolution of man was hastened by the glacial periods, as there is some evidence pointing to his existence in the Tertiary. See also GEOLOGY; PALEONTOLOGY; ICE AGE; ANTHROPOLOGY.

S. F. K.

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**CENSORS**, Roman magistrates early created to establish the property rating and social status of all inhabitants. They were elected in the *comitia centuriata* (see *COMITIA*) every five years, and exercised their office for 18 months or longer if necessary. Part of their duty was the exclusion of unworthy senators from the senate roll, the dropping of knights (see *EQUITES*) whose property qualifications were inadequate and the enrollment of such new members as qualified. They could also inflict punishment in various forms for cowardice, squandering patrimony, luxury, corrupting judges, etc.

**CENSORSHIP**. Only among Anglo-Saxon peoples has the question of stage censorship become a distinctive issue in itself. While the other countries have often censored the theater for political or social reasons, they have not tried by prescription or legislation so to overawe the dramatist as to limit his mental attitudes or to clip his treatments. Monarchs, prime ministers and dictators have closed theaters and punished actors and writers for offense; audiences, as only within recent years in Paris, have shown their open displeasures, resulting in the withdrawal of a play; ideas in plays have been rejected merely because they were ahead of their times. But prescription by definition of what is moral or not moral, what is profane or not profane, is largely an Anglo-Saxon flowering.

The history of the English theater shows a long continued struggle to free the stage from various confining handicaps. An act of 1607 aimed to restrain players from jesting against the name of God, and put all plays directly under the surveillance of the Master of Revels, a post that had been created by Henry VIII in 1544, with some such idea as censorship in mind. By 1628, the theaters, through the Master of Revels, were in the hands of the Lord Chamberlain. When Charles II was restored to the throne, there began that system of theater monopoly which lasted well on into the 19th century, and by the time this monopoly was done away with, the theater was well-gripped by censor supervision.

Though the drama of the Restoration escaped much official supervision, it was met with the attack hurled against it by Jeremy Collier who, in 1698, published his *A Short View of the Immorality and Profaneness of the English Stage*. The strength of his position lay in the fact that DRYDEN, WYCHERLEY, APHRA BEHN and CONGREVE all knew to what limits the Restoration stage had gone in the matter of outspoken frankness. Collier's charges were against such plays as Congreve's *Old Bachelor*, *The Double Dealer* and *Love for Love*, also against Vanbrugh's *The Provok'd Wife* and *The Relapse*. His attack was met by rejoinders from Charles Gildon, Edward Filmer, John Dennis, Vanbrugh and Congreve. See also *RESTORATION DRAMA*.

Playwriting was outlawed in 1737, when Sir Robert Walpole, finding himself and his ministry ridiculed in theater pieces by such writers as Henry Fielding and John Gay, forced through Parliament a censorship bill.

This was vigorously opposed by Lord Chesterfield, but was notwithstanding passed as law.

Until 1843, the ways set by Walpole persisted. By the Theatres Act then adopted, the Lord Chamberlain was given complete control of playhouses, with power to license theaters, plays, and in special circumstances to close theaters.

The years have brought various opposition to censorship. In 1832 there was a commission in London appointed to examine into the matter, but though the commission favored abolishing the system, ten out of fifteen witnesses examined favored it. In 1865, 21 British playwrights petitioned to have censorship discontinued, but Parliament in 1866 concluded that there was no reason for change. In 1907, 71 British authors condemned censorship. But the only result was a ponderous report published in 1909, and later boiled down to a satisfactory summary by the dramatic critic, John Palmer.

The history of the modern British theater has been one where progress has been made in the face of the censoring of some of the strongest and best dramas characteristic of the modern theater. Various stage societies (see *ENGLISH DRAMA, MODERN*) were organized largely to circumvent governmental censorship; for the Licensor of Plays had refused at various times to grant licenses for such distinctive dramas as Shelley's *Cenci*, Ibsen's *Ghosts*, Maeterlinck's *Monna Vanna*, Brieux's *Maternité* and *Les Trois Filles de M. Dupont*, Shaw's *Mrs. Warren's Profession*, and H. Granville-Barker's *Waste*. Censorship has always been a deterrent to the British dramatist. The general feeling in England seems to be that though the censor is not wanted, the working of censorship in London is better than the offensiveness of "watch" committees.

From the very first years in the history of the American theater, Puritanism fought against the playhouse and the actor. (See *AMERICAN DRAMA*.) The story of the agitation for legal censorship in America begins with the rise of ANTHONY COMSTOCK into public notice. The machinery for his endeavors was the Society for the Suppression of Vice. Much of his training had been received as a special agent for the Federal Post Office authorities. Then followed his "watch" society in New York, called the Society for the Suppression of Vice, which unofficially and with no civil authority in itself, has prosecuted cases in the realms of art, literature and public morals that are outside the self-constituted standards of morality set by it. The society was founded in the fall of 1873, as an outcome of the Y.M.C.A. Committee for the Suppression of Vice; John Sumner became associated with it in 1913. A similar organization is the Watch and Ward Society of Boston.

Since 1905 there has periodically sprung into notice the threat of censorship, ending in the general belief that there are adequate municipal laws to govern theaters where arrant defiance of decency was evident. In Oct. 1921, the New York police interfered with a play called *Demi-Virgin* and the Appellate Division of the New York courts declared that the



New York Commissioner of Licenses had no right to revoke the license. The temper of the situation being such that it seemed as though an official censorship might be thrust upon the theater, Winthrop Ames and Owen Davis in the Spring of 1922 suggested a jury plan of settling questions of morality in the theater, but as far as New York City is concerned, this was not found to be practical. The matter has received careful consideration from the Dramatists' Guild of the Authors' League of America, the Actors' Equity, and the Producing Managers' Association. In addition, a Citizen's Committee for a Clean Stage has enlisted the efforts of the clergy. In the meantime, such plays as *The Hairy Ape*, *Desire Under the Elms* and *Strange Interlude*, by Eugene O'Neill, Sholom Ash's *The God of Vengeance*, Schnitzler's *Reigen*, and Bourdet's *Captive* have been called before juries and have received various court decisions showing how wildly and indiscriminately this matter of censorship is considered.

In 1931 there was upon the statute books of the State of New York the menace which lay in the Wales Law, which enabled a theater to be padlocked on the conviction of a manager and his company playing in a piece considered, on complaint, to be a public nuisance. The advocates of censorship argue that it is necessary to keep in check the tendency of the stage towards "indecent" and "immorality." These rather loose terms are made to include acts of "indecent" exposure, the use of certain tabu words or allusions, the depiction of situations or relationships which may be regarded as shocking or improper, actions which may be regarded as coarse or vulgar, blasphemous or sacrilegious utterances or themes, seditious or anti-patriotic utterances or themes, the advocacy or even impartial discussion of heterodox or radical social, economic or moral doctrines. The opponents of censorship contend that the offenses enumerated are incapable of exact definition; that standards of decency, morality and propriety vary not only with time and place, but with the intelligence, degree of education, traditions and social status of individuals within a given community; and that, in the long run, the exercise of public taste through the support or nonsupport of specific theatrical entertainments offers a better index to popular standards of morality, at a given time and in a given place, than does the arbitrary exercise of power by political appointees. It is important to note that while the theater is comparatively free, the motion pictures and the radio are subject to rigorous official censorships.

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**CENSORSHIP, MILITARY**, a policy of suppressing or restricting freedom of speech and the press in time of war or public disturbance for the purpose of keeping from the enemy information which might be of value in connection with military operations,

with the further purpose of protecting the civilian population against the discouragement and loss of morale that a realization of the true state of affairs might bring about. It is quite probable that in many situations such action accomplishes its purpose. To the extent to which censorship is necessary, however, democratic government has, by definition, abdicated.

**CENSUS, BUREAU OF.** Under the DEPARTMENT OF COMMERCE, has as its chief duty the taking of the decennial census of the United States. Through this bureau statistics are compiled on population, agriculture, irrigation, drainage, manufactures, mines and quarries, distribution and unemployment. Special censuses are taken of financial conditions, religious bodies, persons confined in institutions, public utilities, agriculture and manufactures. Vital statistics and marriage and divorce figures are compiled annually. A running survey is kept of the trend of business conditions with monthly or quarterly reports on the production, supply and distribution of cotton, wool, leather, clothing and similar commodities. The Bureau publishes the *Official Register of the United States*, a compilation of the names, titles and salaries of higher administrative and judicial officers. The personnel of the Bureau is headed by a director. There are statisticians for each field of investigation; a geographer, and laboratory workers.

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**CENT**, in music, the  $\frac{1}{1200}$  part of an OCTAVE

which, in a scale of equal TEMPERAMENT, is divided into 12 intervals of the same magnitude. The unit was first adopted by the English writer on phonetics, Alexander J. Ellis (1814-90), in his theory of calculating the vibrations of tone. See also INTERVAL.

**CENT**, a bronze coin equivalent to one-hundredth of a dollar in the United States and Canada, sometimes popularly termed a penny. In Belgium the CENTIME is popularly designated as a cent.

**CENTAUR**, in Greek mythology, a monster which had the body of a horse with shoulders and head of a man. Their human parent was said to be Ixion.



HERCULES IN THE HOUSE OF THE  
CENTAUR POLO  
From a Greek amphora

The centaurs, whose leader was the wise CHEIRON, lived near Mt. Pelion. HERCULES killed many of the centaurs and drove the rest to Mt. Pindus.

**CENTAUREA**, the name of a very large genus of plants of the composite family, many of which are cultivated for their handsome flowers and foliage.

There are about 500 species, mostly annuals and perennials native to the Old World, with showy heads of blue, purple, yellow or white flowers. Among those most widely grown are the bachelor's button or cornflower (*C. Cyanus*), the sweet sultan (*C. moschata*), the dusty miller (*C. Cineraria*), and the basket-flower (*C. americana*). About 10 species have run wild as weeds in the United States and Canada, of which the yellow star-thistle (*C. solstitialis*) and the Napa thistle (*C. melitensis*) have become pernicious in California.

**CENTAURUS** (gen. *Centauri*), a brilliant southern constellation, visible in its entirety only from southern Florida and Texas during early evenings in June. It contains two stars of the first magnitude, Alpha and Beta Centauri, and nearly a dozen stars of the second and third magnitude. The double star ALPHA CENTAURI, with its faint companion PROXIMA CENTAURI, form a system nearer to us than any other star in space. Gamma Centauri, a white star of the second magnitude, situated directly north of the Southern Cross, is composed of two stars. Each is 100 times brighter than the sun. They revolve about each other in 340 years. Their distance from the earth is 80 light years.

The third magnitude star Zeta Centauri, at a distance of 150 light years, is a spectroscopic binary. Its two components are each about 40 times brighter than the sun and revolve around each other in 8 days, with a speed of 200 miles per second. Omega Centauri, appearing to the eye as a star of the fourth magnitude is in reality a star cluster, 21,000 light years distant, and containing hundreds of thousands of stars brighter than the sun. See STAR: map.

**CENTENNIAL EXPOSITION.** See WORLD FAIRS.

**CENTER**, the name taken by the German Catholic party founded in 1870. It won strong support during the next decade as the defender of the Church against the attacks of BISMARCK and the Liberals. As the name implies, it takes a middle ground and, being without extreme opinions, can cooperate with either the Left or the Right. It has had members in all the cabinets under the Weimar constitution and has furnished four of the ten Republican chancellors. The term center is also used in Continental legislatures to characterize the moderate parties, including the above, which occupy seats between the conservative parties of the Right and the socialistic parties of the Left.

**CENTERVILLE**, a city in southeastern Iowa, the county seat of Appanoose Co., situated about 75 mi. southeast of Des Moines. Two railroads serve the city. There is an airport. Extensive coal and gypsum fields are found near by. Centerville is a market for farming products grown in the region. It has machine and railroad shops, and iron and gypsum plants. Centerville was founded in 1846 and was named Chaldea. Pop. 1920, 8,486; 1930, 8,147.

**CENTIGRADE TEMPERATURE SCALE**, a temperature scale in which the fundamental interval (see THERMOMETRY) is divided into 100 degrees. The ice point is marked 0° and the steam point 100°.

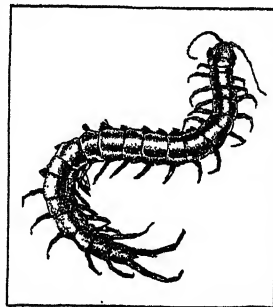
This scale is used almost universally by scientists and is in common use in Europe. Centigrade temperatures are converted into the corresponding Fahrenheit units by the formula,  $F = 32^\circ + \frac{9}{5} C$ , where F and C are the corresponding Fahrenheit and Centigrade readings. Thus, 20° C. corresponds to 68° F. See also FAHRENHEIT TEMPERATURE SCALE.

**CENTIME**, a monetary unit representing the one-hundredth part of the FRANC in France and Switzerland. The smallest coin issued in France is the five centime piece.

**CENTIMETER**, a unit of linear measure of the METRIC SYSTEM comprising 0.01 meters or 0.3937 in. It is approximately equivalent to one-billionth of a quadrant of a terrestrial meridian. A cubic centimeter of pure water at its maximum density, at 4° C., weighs approximately one gram, that relation being the original basis of the unit of weight of the metric system. The centimeter is the unit of measure generally used in scientific work, and it is in common use in Europe.

In the centimeter-gram-second, c.g.s. system, a system of physical units introduced in 1874 for use in science, the centimeter is taken as the unit of length, the gram of mass and the second of time. In this system the unit of force is the dyne, and that of work the erg, or dyne-centimeter. Power is expressed in terms of dyne-centimeters per second, ergs per second or joules, 10<sup>7</sup> ergs, per second.

**CENTIPEDE**, the popular name for members of an arthropod class (*Chilopoda*) whose long, thin bodies are divided into numerous rings, or segments, most of which bear one pair of legs. Some species have only 15 rings while others have as many as 173. Big tropical centipedes may be a foot in length. Although they superficially resemble millipedes, they are more closely related to insects. They are found all over the world, and there are numerous species in the United States.



CENTIPEDE

All of the centipedes are provided with poison, secreted by glands on the first pair of legs, or poison claws, which helps them to overcome their prey. The bite of smaller species sometimes fails to paralyze an earthworm, but that of larger ones may even be dangerous to man.

They frequent dark damp places, and are particularly fond of tiny crevices. Doubtless as a result of their tendency to creep into any orifice, they have occasionally become pseudoparasites in human ears and noses. In the evening they go hunting for insects, earthworms and slugs, and a few species may damage growing plants. Some female centipedes make nests for their eggs and guard them until they hatch. A. I. W.

**CENTO**, a patchwork kind of literary composition in which selections are taken from the work of

a particular author or of several authors, and so pieced together as to give a new sense. Favored by the Byzantine Greeks, the Romans, and in medieval times, the cento is well exemplified by the Empress Eudoxia's *Life of Christ, taken from Horace*, the *Cento Virgilianus* of Proba Falconia (4th century), and the *Hymns to St. Quirinus, taken from Virgil and Horace*, by the 12th century monk, Metellus.

**CENTRAL AMERICA**, the isthmian region between Mexico and South America, comprising the colony of British Honduras and the six independent states of Guatemala, Honduras, Nicaragua, Costa Rica, Salvador and Panama. Its width varies from 75 to 250 mi. The collective area is about 224,960 sq. mi.

A mountain and plateau highland extends longitudinally through the region, following the Pacific coast line towards which it slopes abruptly. The eastern slope is generally gradual, forming broad low jungle valleys in Guatemala, Honduras and Nicaragua, where are found large banana plantations, coconut groves, and dense forests of mahogany, ebony, rosewood, and rubber-producing trees. On the plateaus coffee and sugar are grown, and above 5,000 ft. crops of the middle latitudes are raised. Deposits of gold, silver, copper, lead and tin are known to exist but have not been developed. The deep, rich soil of the plateaus is in many places the accumulation of volcanic cinders and ash.

The lowlands are in the hot belt but the highlands have a mild and pleasant climate. The most important towns and the majority of the people are found in the higher regions. The population is mixed Spanish and Indian.

Of the many volcanoes in the country, the highest peaks are found in Guatemala and extend to over 13,000 ft. Violent eruptions are common and earthquakes are frequent.

The northeast trade winds bring quantities of moisture which gives origin to the luxuriant tropical vegetation. The principal rivers are on the eastern slope and empty into the Caribbean Sea. In Nicaragua are two large lakes, Managua and Nicaragua.

The region of Central America was discovered by Columbus in 1502 and in 1524-25 Cortes conquered it for Spain. Its Caribbean coast is part of the famous Spanish Main. The remains of ancient Mayan civilizations found in Guatemala are of great interest. (See also **BRITISH HONDURAS, GUATEMALA, HONDURAS, NICARAGUA, COSTA RICA, SALVADOR, PANAMA.**)

**BIBLIOGRAPHY.**—H. H. Bancroft, *History of Central America*, 3 vols., 1883; W. H. Koebel, *Central America*, 1917; D. G. Munro, *The Five Republics of Central America*, 1918; M. W. Williams, *The People and Politics of Latin America*, 1930.

**CENTRAL AMERICAN COURT.** See **LATIN AMERICA.**

**CENTRAL BANK**, a relatively new concept distinct from an ordinary commercial bank, whose origin may be ascribed to the events in the life of the Bank of England, which eventuated in the passage of the Peel Act in 1844. A central bank is one which has

as its chief purpose, not the making of profits for the stockholders, but responsibility for the banking reserves of the country and services to the public Treasury. For this reason the central bank is usually subjected to more severe legal restrictions than are commercial banks. In order to conserve and to bring about the concentration of the specie reserves of the country, it is usually required to maintain a definite proportion of specie as a reserve against notes and deposits. Closely related to the problem of centralizing reserves is that of note issue, and in most countries the issue of notes has been, or is now being, concentrated in the hands of the central bank, which is held responsible for their redemption in specie, and for the regulation of the amount of the issue so that neither INFLATION nor DEFLATION occurs. The question of how far a central bank is responsible for the maintenance of a stable price level is still an unsettled one, but there is no doubt that public opinion tends to place blame upon the institution when too easy money leads to speculation and rising prices either of commodities or of securities.

The relation of the central bank to commercial banks varies widely from one country to another. In the United States the Federal Reserve banks are exclusively bankers' banks, in which no individual may have an account, but only banks and a few other financial institutions such as discount corporations. In England and on the Continent on the other hand, central banks usually deal directly with individuals, and even come into competition with the commercial banks. In either case, however, the central bank may exercise a large measure of control over the money market. The most important of the devices by which this is accomplished is the discount rate, the official rate at which eligible paper may be rediscounted (see **REDISCOUNTING**) at the central bank usually for banks in need of additional funds. Another more recently developed technique for the same purpose is the use of open-market operations. The central bank, instead of discounting only the paper presented to it, takes the initiative and buys or sells securities or bills of exchange in the market.

Central banks also serve as the agent of governments in the money market, facilitating loans and their repayment, and easing the strain of large government receipts and disbursements. During the World War central banks were forced to subordinate their policies to the needs of war finance, assisting in the process of inflation. When the war was over they were faced with the necessity of deflation and stabilization. So essential were the services of central banks in this process of recovery that the International Financial Conference at Brussels, in 1920, recommended the establishment of a central bank in every country, not yet possessed of one, as a first step on the road to stability. Most of the new countries created by the Treaty of Versailles have followed this advice, and a number of the older countries have also established such banks since the war. Among them are Czechoslovakia, South Africa, Latvia, Lithuania,

Peru, Danzig, Poland, Hungary, Chile, Esthonia and Bolivia. With the creation of so many new central banks, the financial history of the world has entered upon a new phase. Since each of these countries now has a responsible financial representative, international cooperation and international loans are immensely facilitated. Central banks have played an important part in the payment of WAR DEBTS, and the Bank for International Settlement, organized as a part of the Young Plan for settling the war debt problem, would hardly have been possible without the existence of central banks in all the important countries. *See also* BANK OF ENGLAND; BANK OF FRANCE; REICHSBANK; BANK RESERVES; DISCOUNT RATE; FOREIGN EXCHANGES AND CENTRAL BANKS; GOLD; MONEY MARKET; REDISCOUNTING.

B. H. B.

**CENTRAL FALLS**, a city of Providence Co., R.I., 5 mi. north of Providence, on the Blackstone River and served by the New Haven Railroad. First settled in 1763, the town from 1780, when a chocolate mill was built here, until 1827 was called Chocolateville. Incorporated 20 years later as Central Falls Fire District of Smithfield, the town became a city in 1895. Cotton mills and other factories receive water power from the Blackstone. In 1929 the value of manufactures was about \$25,000,000; the retail trade amounted to \$5,118,791. Pop. 1920, 24,174; 1930, 25,898; about 38% were foreign-born.

**CENTRALIA**, a city of Clinton and Marion counties, Ill., 70 mi. east of St. Louis, Mo. It is on four railroads, two of which maintain repair shops. A Federal highway and a municipal airport also serve the city. In 1929 the value of the local manufactures was about \$1,000,000; the retail trade amounted to \$7,762,257. Fruit and dairy farming are the chief interests of the surrounding territory. There are also coal and oil resources. Pop. 1920, 12,491; 1930, 12,583.

**CENTRALIA**, a city in Lewis Co., southwestern Washington, situated 65 mi. southwest of Tacoma. It is served by four railroads, bus and truck lines and an airport. The city is in a highly productive lumbering and coal mining region. Poultry, dairying and strawberry farming are the leading agricultural interests. Centralia has lumber mills, wood products factories and other industrial establishments. The old blockhouse, built in 1856, still stands in Borst Park, adjoining the city. Centralia was founded by a freed negro in 1875 and was incorporated in 1890. Pop. 1920, 7,549; 1930, 8,058.

**CENTRAL PARK**, a well-known park in New York City, extending from 59th St. to 110th St.; an area  $2\frac{1}{2}$  mi. long,  $\frac{1}{2}$  mi. wide and containing 843 acres. When the land was purchased by the city in 1856 for about \$6,250,000, it was a suburban district of the lowest order. The first engineering surveys were made in 1857 by Lieutenant Egbert L. Viele, with landscaping under the supervision of Messrs. Olmsted and Vaux, the winners of a public contest for suitable designs. In 1885 the park was opened to the public. Central Park now has 23 gates, each named, and a cross-town street car line at 86th St.

There are more than 10 mi. of roads, the most famous being the East and West drives and 5 mi. of bridle paths. Points of interest in the park are the Metropolitan Museum of Art and, nearby, Cleopatra's Needle, an Egyptian obelisk, a small zoological park, a botanical garden and conservatory, and the Mall, paved and tree-lined, where free band concerts are given in the summer. Two lakes, one near the West 72nd St. entrance and the other at 110th St. provide excellent boating and skating facilities; in addition there is a distribution reservoir for the city water supply. The most noted statues in the park are those of Simon Bolivar, by Sally James Farnum, Albert B. Thorvaldsen, by himself, and figures of Giuseppe Mazzini, Daniel Webster and Alexander Hamilton.

**CENTRAL POWERS**, the name given to Germany and Austria-Hungary during the World War, because of their location in central Europe. The other member of the TRIPLE ALLIANCE of 1882, Italy, was one of the Central Powers until her withdrawal from the Alliance in 1915. After the defection of Italy, Bulgaria and Turkey, as allies of Germany and Austria-Hungary, were included in the general understanding of the name.

**CENTRE COLLEGE**, an institution at Danville, Ky., founded in 1819. Until 1830 it was under state control, but since then has been privately controlled, under the supervision of the two Presbyterian Synods of Kentucky. The productive funds of the college in 1931 were \$1,251,124. The library contains 43,319 volumes and a fine Dante Collection. In 1930 there were 409 students and a faculty of 28, headed by Pres. Charles J. Turck.

**CENTRIFUGAL FORCE:** *See* CENTRIPETAL FORCE.

**CENTRIFUGE**, a machine used in separating foreign matter from liquids, liquids from solid substances and liquids of one density from liquids of another density by centrifugal force (*see* CENTRIPETAL FORCE). The centrifuge is, essentially, a cylindrical vessel mounted on a driving mechanism so that it may be rotated at a high rate of speed, pans or troughs being provided to catch the separated substances and run them into containers. If the centrifuge has a container of perforated metal or wire gauze, materials such as textiles and silk may be dried by the machine, the water being thrown out by centrifugal force. Such machines are used in sugar refineries, laundries and laboratories. The cream separator is a type of centrifuge used to separate cream from whole milk, the heavier milk being thrown farther from the rotating element than is the cream.

**CENTRIPETAL FORCE.** A body continues in its state of rest or of uniform motion in a straight line unless acted upon by some outside force (*see* INERTIA). By this principle, a force is required to start a body from rest or to stop it once it is in motion; also, if a body is moving in a straight line, a force is required to move it sidewise out of that path.

An automobile, running along a straight road, comes to a curve which bears to the right. To make





CENTRAL AMERICA

**BRITISH HONDURAS**  
Area...8,598 sq. m.  
Pop.....51,228

**PRINCIPAL CITY**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
17 Belize.....B 8

**CANAL ZONE**  
Area...549 sq. m.  
Pop.....39,467

**COSTA RICA**  
Area...23,000 sq. m.  
Pop.....516,031

**PRINCIPAL CITIES**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
55 San Jose...O 14

**GUATEMALA**  
Area...2,353 sq. m.  
Pop.....2,163,546

**PRINCIPAL CITIES**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
121 Guatemala G 4  
30 Quezaltenango F 3

**HONDURAS**  
Area...44,275 sq. m.  
Pop.....859,761

**PRINCIPAL CITIES**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
12 Cholotepec...I 9  
24 San Pedro E 8  
40 Tegucigalpa G 10

**NICARAGUA**  
Area...51,660 sq. m.  
Pop.....750,000

**PRINCIPAL CITIES**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
15 Bluefields...K 15  
25 Granada...K 11  
50 Leon.....J 10  
50 Managua...K 11

**PANAMA**  
Area...32,358 sq. m.  
Pop.....467,459

**PRINCIPAL CITIES**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
30 Colon.....O 21  
74 Panamá...P 22

**SALVADOR**  
Ar...13,176 sq. m.  
Pop.....1,437,365

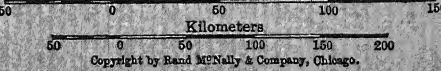
**PRINCIPAL CITIES**  
(Including Figures from Latest Population Estimates)  
**Pop.—Thousands**  
39 San Miguel H 8  
96 San Salvador H 6  
76 Santa Ana...C 6  
29 Santa Tecla H 6



CENTRAL AMERICA DEPARTMENTS	
GUATEMALA:	SALVADOR:
1 Guatemala	1 San Salvador
2 Amatitlan	2 La Libertad
3 Escuintla	3 Sonsonate
4 Suchitupéquez	4 Ahuachapán
5 Retalhuleu	5 Santa Ana
6 Quezaltenango	6 Chalatenango
7 Solola	7 Cuscatlan
8 Chimaltenango	8 Cabañas
9 Sacatepequez	9 San Miguel
10 Totonicapan	10 Morazan
11 San Marcos	11 La Union
12 Baja Verapaz	12 Usulután
13 Santa Rosa	13 San Vicente
14 Jalapa	14 La Paz
15 Jutiapa	
16 Chiquimula	
17 Zacapa	
18 Alta Verapaz	
19 Huehuetenango	
20 Izabal	
21 Petén	
22 Quiché	

RAND McNALLY  
POPULAR MAP OF  
CENTRAL AMERICA

SCALE 1:5,576,000  
1 Inch = 38 Statute Miles  
1 Centimeter = 55.8 Kilometers



Longitude West of Greenwich



that auto swerve to the right, some force must pull it in that direction and away from the straight path. This force always acts toward the center of curvature of the road and is called the centripetal force.

Centripetal force, like every other force, produces, or tends to produce, an acceleration. In this particular case, we call it the centripetal acceleration. It, too, is always directed toward the center of curvature. Centripetal acceleration,  $a_c$ , has a numerical value equal to the square of the linear velocity,  $v$ , in the curved path divided by the radius of the curvature  $r$ .

It may be expressed by the equation,  $a_c = \frac{v^2}{r}$ . In general,  $\text{Force} = F = ma$ , where  $m$  is the mass and  $a$  the acceleration of the body. In the case of centripetal force,  $F_c = \frac{m v^2}{r}$ . Interpreting this equation,

the force necessary to pull the automobile out of its straight path is directly proportional to the mass of the vehicle and to the square of its speedometer reading and inversely proportional to the radius of the curve about which it is constrained to go.

This problem may take on another point of view. Matter tends to move in straight lines. The automobile tends to go straight and not go around the curve. The sparks from an emery wheel do this very thing, as does the mud from a rapidly rotating wheel. Instead of speaking of the force which constrains the auto to go in a curved path, one may speak of its tendency to fly off on a tangent. This tendency is called the *centrifugal force* of the body. It is just equal and opposite to the centripetal force. Thus, the equation for centripetal force is also that for centrifugal force.

The equation,  $F_c = \frac{m v^2}{r}$ , says that the tendency for an automobile to skid, i.e., to keep on going in a straight line when going around a corner, is proportional to its mass and to the square of its velocity. Furthermore, the sharper the curve, i.e., the smaller  $r$  is, the greater will be the tendency to skid. This all fits in with the motorist's everyday experience, only many drivers fail to sense the significance of speed in rounding a corner. If a motorist doubles his speed in going around a corner, he quadruples the force which tends to throw his car into the ditch.

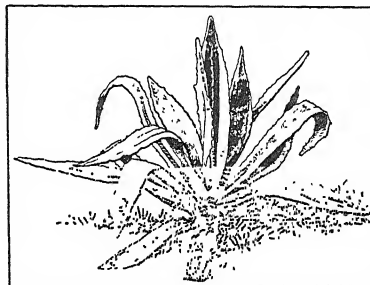
A rotating sphere, cylinder or flywheel has its centripetal and centrifugal forces just equalized. If the speed goes beyond a certain value, the centrifugal force becomes greater than the inter-atomic forces which hold the body together. As a result, the rotating body flies apart and the pieces go off on tangents to the circles in which they were moving.

S. R. W.

**CENTUM-LANGUAGES**, a group of INDO-EUROPEAN languages characterized by retention of the palatal character of Indo-European  $k$  instead of its transformation into a sibilant, as in the SATEM-LANGUAGES, the designation being taken from the LATIN and AVESTA representatives of the Indo-European

word  $*kmtó-m$  for  $*dkm-tó-m$  "hundred," *centum* and *satem* respectively, as Greek *he-katon*, Gothic *hund*, Old Irish *cét*; but Sanskrit *śatám*, Old Church Slav *sūto*, Lithuanian *šimtas*. The *centum*-group includes Kanisian (?), Greek, Italic, Ligurian, Celtic, Germanic and Tokharian, of which only the first and the last are found outside Europe. See separate articles on these subjects.

**CENTURY PLANT** (*Agave americana*), a striking plant of the AMARYLLIS family, so named because of the erroneous notion that it blossoms only when it has attained the age of 100 years. The century plant, known also as AGAVE and American ALOE, is



YOUNG CENTURY PLANT

native to arid regions in tropical America, especially in Mexico, where it is extensively cultivated for economic uses. The plant, which is almost stemless, bears a great rosette of massive, widely spreading leaves, 3 to 6 ft. long. Along the edges and at the point the leaves are armed with stout spines. Composed of firm tissue interspersed with strong fibers, the leaves are very durable, often persisting many seasons. At maturity, reached in about 10 years, the plant sends up a huge flower-stalk, which grows with great rapidity, sometimes 5 in. in a day, attaining a height of 20 to 40 ft. On horizontal branches near the summit are borne large clusters of erect, somewhat lily-like, yellowish-green flowers, about 2½ in. across. Upon the ripening of the seeds, the plant dies, but suckers, previously developed at the base, often give rise to new plants. In Mexico the fermented sap furnishes the national beverage, pulque. Valuable fibers, as Pita flax and sisal, are also products of the century plant and closely related forms. The century plant has become naturalized in the Mediterranean region and other warm countries. In cooler climates it is often grown as a tub-plant, especially varieties with striped leaves. When so grown the century plant requires a soil consisting chiefly of loam and sand and should be firmly potted.

**CEPHALIC INDEX**, a system designed to express the percentage or proportion that the width of the head bears to its length. It is calculated by dividing the head length into the head width multiplied by 100. According to the index obtained the shape of the head is described as dolichocephalic (narrow-headed), mesocephalic (medium-headed) and brachycephalic (broad-headed). Numerically they are classified as follows:

Hyperdolichocephalic	below 69.9
Dolichocephalic	70 to 74.9
Mesocephalic	75 to 79.9
Brachycephalic	80 to 84.9
Hyperbrachycephalic	above 85.0

On the living these classifications are two units higher. The cephalic (cranial index when obtained from the skull) index is frequently used as a criterion of race, but modern anthropologists tend to deny its significance when used alone. H. L. S.

**CEPHALONIA**, or Kephallenia, the largest of the IONIAN ISLANDS, lies west of Greece on a line with the Gulf of Corinth. It is 32 mi. long and from 5 to 20 mi. wide. It is mountainous, its highest peak, Aenos, being 5,315 ft. above sea level. Argostoli is its chief town. At different times it has belonged to Rome, Venice, Turkey, France and England, but now belongs to Greece. Its important products are fruits, oil and cotton. Pop. 1928, 66,414.

**CEPHALUS**, in Greek mythology, grandson of AEOLUS and husband of Procris. Cephalus killed



COURTESY M. M. OF ART

EOS PURSUING CEPHALUS

Scene on a Greek vase from Gela, about 460-420 B.C.

Procris by mistake as she was spying on him. In remorse he went to live in the island of Cephallenia, which was named for him.

**CEPHEID VARIABLE.** See CEPHEUS.

**CEPHEUS** (gen. *Cephei*), a northern constellation between Cygnus and the Pole, is always visible in the United States. The constellation was named after the legendary king Cepheus of Ethiopia, husband of Cassiopeia and father of Andromeda. Its brightest stars are of the third magnitude. It contains among others Mu Cephei, the garnet star, deep red in color, and the variable star Delta Cephei which is the type star of the Cepheid class of variable stars. See STAR: map.

**CEPHISODOTUS:** (1) Greek sculptor of the 4th century B.C., elder brother or father of PRAXITELES. A copy of his statue, *Peace Bearing the Infant Wealth*, is now in Munich. (2) Another Greek sculptor, called "the Younger," also of the 4th century B.C., son of Praxiteles. The portrait bust of Menander was executed by him and his brother Timarchus, as evidenced by the finding of the names of the artists in its base. Otherwise nothing of his work is extant. Some students think there was only one Cephisodotus.

**CERAM** or **SERANG**, an island of the Dutch East Indies, second largest of the MOLUCCAS. It lies east of Buru, being separated from it by the Manipa Strait. Ceram is 216 mi. long and covers over 6,000 sq. mi. Its surface is heavily forested and mountainous, rising to 9,612 ft. above sea level in Mt. Nusahili, the highest peak. The chief agricultural products are rice, tobacco, coconuts, sugar cane and maize. Est. pop., about 80,000.

**CERAMICS**, the art of making articles of baked clay. According to the Greek origin of the word, the meaning was the art of making pottery alone. But the definition was afterward enlarged to include the forming of all objects produced from earthy materials and made permanent by fire. The variety of these objects is very great. It includes structural materials of many kinds; BRICK, hollow blocks, TERRA COTTA and TILE; sewer pipe, drain tile and conduits; refractory wares used in metallurgy and in gas manufacture, furnace blocks and boiler fittings; cements, plasters and limes; pottery of all kinds, PORCELAIN, EARTHENWARE and FAIENCE; bath tubs and sanitary wares; enamels for metal utensils and jewelry; glass for windows, optical instruments and table use; electric insulators and fittings and spark plugs for automotive engines. (See CLAY PRODUCTS.) The variety of materials is also great. For the finer products, the purer clays and minerals are sought; but these are comparatively rare and, therefore, costly. For refractory wares, especially where very high temperature conditions must be met, pure materials must be used, but where the appearance of the product is not a factor a greater variety is permissible. The exigencies of modern manufacture, especially in the extended use of high temperatures, have made heavy demands upon the makers of ceramic wares, severely taxing the resources of science. Many colleges are now including ceramic engineering in their curricula, and men are being graduated who are capable and well-informed.

The use of clays was not among the earliest activities of the human race, but, because of the durable nature of pottery, it forms the most valuable aid to the archaeologist. During the Neolithic age pottery was made in many parts of the world. Some of the fragments exhibit a high degree of skill both in form and decoration. The potter's wheel seems to have been devised in several widely separated localities, but while the processes of making were facilitated, no great advance in technique was made, through its invention. The wheel was used in Egypt, but its great possibilities were revealed in Greece. The wheel work of the Greek potters has not been equalled even by the Chinese, and it is unlikely that any equivalent perfection will be reached. Each nation during some period of its history has produced a style of pottery more distinctive than the style of kindred arts, because clay in its plastic state is preeminently impressionable and because baking has rendered the product imperishable. The contribution of the Chinese people was the use of increasingly high temperature in firing. These made useful the purer forms of clay



which could not be hardened in more moderate fires. Thus, the way was prepared for the production of porcelain, the greatest achievement of the potter.

Although the fall of Rome and the rise of the Mohammedan power were attended by chaotic conditions which continued for many years, in the 13th century pottery making showed signs of reviving. In the Near East, in Persia, Turkey and North Africa there was developed a distinctive technique. By the use of a sandy clay a very beautiful and original fabric enriched with colored designs and covered by an alkaline glaze, resulted which is now fully represented in all the best collections. In the 15th century arose a vogue of white pottery, probably inspired by the porcelains from China, then finding their way to the markets of the world. The Mohammedan potters simulated them by coating or veneering their dark colored clay with a thin film of white material consisting largely of finely ground quartz. This coating received from the French the name *engobe*, by which it is generally known. In Spain, Italy and France, however, a different expedient was adopted. Experiment showed that the glaze itself could be opacified by the introduction of a small proportion of the white oxide of tin. This technique rendered the *engobe* unnecessary, and simplified the process of production. From it came the type of pottery known as *MAJOLICA*, derived from Majorca, the Spanish island which was one of the sources of the product. In Italy the fabric reached a high degree of excellence, and the French potters adopted it. In France, too, there was developed the white china which was perfected at the royal manufactory of Sèvres. In Germany during the same period there was made the brown and gray ware named stoneware, and in 1710 the first known deposit of china clay in Europe was discovered. This resulted in the production of a true porcelain at Meissen, Saxony. The technique of this ware speedily spread over Europe, and with minor changes exists to-day. With the exception of a short-lived enterprise at Plymouth and Bristol, porcelain was not made in England. Instead there was developed a china based on the use of bone ash which has ever since been the characteristic English type. In the United States the manufacture of pottery has reached considerable proportions. There is a large trade in both tubs and bath room fittings, and a great quantity of a strong earthenware is made for domestic and restaurant use. There is also manufactured a good quality of china, not as delicate as that of the European nations but more serviceable. The extensive use of electricity has made exacting demands upon the ceramic industry for porcelain insulators, the finest materials being required for efficient service.

C. F. B.

**CERARGYRITE**, also called horn silver, a rich ORE of silver developed near the surface by WEATHERING of other silver minerals. It usually occurs as a crust of wax or horn-like appearance, but isometric crystals are also found. It is the chloride of silver. The wax-like appearance and consistency are typical.

Notable occurrences are in Peru, Chile and Mexico, and also in New South Wales, western United States, Germany and Norway. See also ISOMETRIC SYSTEM; ORE DEPOSITS.

**CERBERUS**, in Greek mythology, the watchdog who guarded the gates of HADES so that no one should escape. He was supposed to have two or more heads and a tail of serpents which wound around his body. One of the labors of HERCULES was to bring him from the infernal regions. There is a constellation of this name.

**CEREALS**, a term for seeds of grasses used as food, such as WHEAT, CORN, OATS, RICE, BARLEY, and RYE. Cereals, one of the oldest food staples known, usually make up one-quarter of man's diet in the United States, and even a greater proportion when economic status is below the American average. Cereals are inexpensive, because they are easily grown, easily stored, and by fairly simple processing become palatable, nourishing food.

Cereals include both flours and breakfast foods. Wheat and rye are used chiefly for flour; rice is most widely used as an article of food. White or patent flour is made by pulverizing the inside of wheat kernels after removing bran coats (*see* BRAN) and wheat germ. Graham flour contains bran coats and germ; whole wheat flour has part of the bran removed. Flours and breakfast foods may be refined or unrefined; both are valuable sources of carbohydrates. Unrefined cereals are made from whole grain and are considered valuable because of minerals, vitamins, and protein content which refined cereals lack.

Breakfast foods may be divided into three groups: raw, partially cooked, and ready-to-eat. *Raw cereals* are generally made from wheat, rice, oats, or corn. The grain is thoroughly cleaned, then sterilized. It is left whole, cracked, or crushed by steel rollers according to the product desired. Cracked wheat and rolled oats are two examples of raw cereals. Raw cereals require one to three hours' cooking to make them readily digestible and to develop their full flavor.

*Partially cooked cereals* consist of grain usually cleaned, sterilized, rolled between heated steel rollers, then cleaned again. During the rolling, the product is partially cooked, thus shortening the cooking period for the consumer. Quick-cooking oatmeal is an example of a partially cooked cereal.

*Ready-to-eat cereals* are made from wheat, oats, corn, rice, and barley, separately or in combination. They may be rolled, flaked, malted, or puffed—refined or unrefined—according to the processing of the individual product.

Flaked cereals are generally processed as follows: cleaned grain is placed in large cookers and steamed slightly to soften the kernels, then passed into machines which remove the outer hulls and germs, and crack the kernels into several pieces called grits. The grits, flavored with sugar or syrup, are next thoroughly mixed and placed in large revolving cylindrical steam cookers, in which they are evenly cooked to the proper consistency; they are then conveyed to revolving dry-



ing cylinders where the surplus moisture added during the cooking process is forced out by hot air. The dried grits are then passed between revolving rollers, are rolled into flakes, and are quickly toasted over intense heat.

Malted cereals are some of the ready-to-eat cereals which have been treated with malt during processing. These cereals are considered more digestible than others since the addition of the malt converts to some extent the STARCH of the grain into sugar, thus somewhat simplifying the process of digestion.

**CEREAL PREPARATIONS**  
MANUFACTURES, U.S.

Item	1929	1927
No. of establishments .....	97	77
No. of wage earners .....	5,973	6,028
Total wages .....	\$ 8,178,357	\$ 8,417,246
Cost of mat., containers for products, fuel & elec. current ....	79,707,841	91,748,332
Total value, products .....	147,646,081	155,563,286
Value, cereal preparations .....	117,612,258	116,538,195
Value added by manufacture:—		
Total .....	67,938,240	63,814,954
Per wage earner .....	11,374	10,586
Principal products:—		
Breakfast foods .....	104,044,368	103,565,397
Made from wheat .....	40,742,374	37,046,915
oats .....	34,067,391	38,720,727
corn .....	19,789,131	19,548,690
other grains .....	9,445,472	8,249,065
Prepared flour .....	8,256,883	5,868,311
Coffee substitutes .....	5,090,790	6,071,751
Other cereal preparations ....	220,217	1,032,736

Puffed cereals are processed by placing the cleaned grain in sealed revolving cylinders and subjecting it to a high temperature for about one hour. This heat converts the moisture of the grain into steam, and the cylinders are then quickly unsealed. Sudden unsealing of the cylinders causes the steam to burst the starch grains and puff each separate granule. M.S.

**CEREBRAL HEMORRHAGE.** See **APoplexy**; **PARALYSIS**.

**CEREBROSPINAL MENINGITIS.** See **MENINGITIS**.

**CERES**, the Roman name for the Greek **DEMETER**. Ceres's temple in Rome stood on the Aventine Hill.

**CEREUS, NIGHT-BLOOMING**, the name given to various climbing cactuses (*Hylocereus*, *Selinicereus*, and others), comprising 18 species native to tropical America. The long, three-angled, sometimes three-winged, slightly spiny stems, which cling to walls and similar supports by means of aerial roots, bear very large funnel-shaped white or rarely red flowers, blossoming only at night, and spineless, scale-covered, fleshy berries, usually of large size and edible. The best known species, *Hylocereus undatus*, grown in tropical countries for hedges and widely cultivated as a conservatory plant, produces magnificent flowers about a foot long, with pure white petals surrounding cream-colored stamens and stigmas. A closely related night-blooming cactus, *Selinicereus pteranthus*, native to Mexico, with a six-angled, vinelike stem bearing

very fragrant white flowers, a foot long, is frequently grown in conservatories.

**CERIGO.** See **CYTHERA**.

**CERIMAN** (*Monstera deliciosa*), a tall strong climber of the arum family, native to Mexico and Central America, and widely grown in greenhouses as an ornamental. It is a stout straggling plant with hanging, cordlike roots and large thick leaves, 2 to 3 ft. long, which are perforated with numerous oblong or elliptical spaces, thereby appearing full of holes. The white flowering spathe surrounds a spadix about 10 in. long, which matures into a large fleshy fruit, much prized in the tropics for its luscious pineapple flavor. See **ARUMS**.

**CERIUM**, a metallic chemical element (symbol, Ce., at. wt. 140.13) belong to the **RARE EARTHS**. It was discovered in 1803 by Klaproth, and occurs in many minerals, notably cerite and monazite. It is the only one among the rare earths which may be tetravalent and form ceric salts, yellow to orange in color, in addition to the colorless cerous salts, analogous to the compounds of the other elements of its group. Metallic cerium is soft, malleable and ductile, melts at 623° C. and burns easily in air. The alloy of cerium with a number of other rare earths, called "misch metal," often still further alloyed with iron, makes excellent flints for cigar lighters. The principal use for cerium is in the form of an admixture of about 1% cerium nitrate to the thorium nitrate solution used in coating incandescent gas mantles. Cerium oxalate is used to allay sea-sickness.

**CERNAUTI**, Czernowitz, capital of the Bukovina, a Rumanian country since 1919, is located near the Pruth River close to the Polish frontier. It has two Roman Catholic churches, a Greek Oriental cathedral, an Armenian Catholic church and a synagogue. There are also a theater, library, botanical garden, museum, and trade and vocational schools. The university, founded in 1875, has been partially closed. Agricultural products, wood, wool and cattle are the chief articles of trade. The first record of the city dates from 1408. Austrian since 1774, it was in 1816 a town of but 5,416 inhabitants. A bone of contention, during the World War it was occupied by Ukrainians in 1918, but nevertheless was allotted to Rumania by the Peace of St. Germain. Pop. 1930, 111,122.

**CERRO GORDO, BATTLE OF**, Apr. 18, 1847, a battle of the **MEXICAN WAR** which resulted in the defeat of Gen. Santa Anna with 12,000 troops by an American army of 8,500. Having put Vera Cruz under military government, Gen. Scott proceeded toward Mexico City. Simultaneously Santa Anna, having reorganized his army after the disastrous defeat at Buena Vista, marched to intercept him. The Mexican army took its position at Cerro Gordo, a mountain pass 60 miles from Vera Cruz. On the 18th Scott attacked, and by noon the Mexican army was in confusion. The Mexicans suffered casualties of over 1,000; 3,000 were taken prisoners, and 40 cannon captured. The American loss was 63 killed and 368 wounded.

**CERTIFICATE OF DEPOSIT**, a bank's written acknowledgment of the deposit of an amount of money. It is negotiable in the United States since funds deposited under it can not be withdrawn unless it is presented at the bank. It may be used as collateral for a loan.

**CERTIFICATE OF INDEBTEDNESS.** Methods of short-term borrowing essentially similar to the certificate of indebtedness were utilized by the United States Government in many crises of its history, but in the war period 1917-1918 they formed an essential part of the Treasury program, and have been used regularly ever since, as a means of easing the effects of tax collection and disbursement on the **MONEY MARKET**. During the war these short-term notes were bought by banks and then used in the purchase of Liberty loans, thus spreading the payment to the government over a longer period.

Subscriptions are made to these issues through the Federal Reserve banks, which invite the member banks of their respective districts to subscribe. When the certificates are issued in advance of tax payments, or loan subscriptions, the Treasury redeems them as the expected funds are received. At other times the notes are funded into securities of longer maturity. Certificates of indebtedness may have a maturity of a few days or a few months; longer issues are usually termed Treasury notes. *See also* **TREASURY NOTES**.

**CERTIFIED CHECK**, a check the payment of which is guaranteed by the bank on which it is drawn. It is a regular depositor's check but has certified, accepted or their equivalent together with signature of a bank official written or stamped across its face by the cashier or the paying teller of the bank. The certified check is backed by cash set aside by the bank from the depositor's account.

**CERTIORARI**, a writ issued by a court requiring that the proceedings of a lower court, tribunal or board be brought before it for review. It is an old **COMMON LAW** proceeding now enlarged by statutes. It does not undertake to pass on the rights of litigants, but on the question of jurisdiction of the court or body reviewed. The character of the act or determination sought to be reviewed, determines whether or not it is subject to the jurisdiction of the tribunal or body before which it was brought.

**CERUSSITE**, sometimes called white lead ore because it is a valuable **ORE** of that metal. It is usually white but may be gray or brown. Frequently it carries silver. Cerussite, lead carbonate, crystallizes in the **ORTHORHOMBIC SYSTEM**. It results from the **WEATHERING** of other lead minerals, notably **GALENA**, and is commonly found near the surface. It occurs in New South Wales, Siberia, Germany, the British Isles, and in the United States in Utah, Colorado, Wisconsin, Missouri and Virginia. *See also* **ORE DEPOSITS**.

**CERVANTES SAAVEDRA, MIGUEL DE** (1547-1616), Spanish novelist and poet, was baptized at Alcalá de Henares, Oct. 9, 1547. His parents wished him to adopt a more lucrative profession than poetry, which he began writing at an early age. In

1569 he left Madrid, where he had written a pastoral, *Fileña*, and went to Italy, becoming a page in the employ of Cardinal Acquaviva at Rome. The following year Cervantes turned soldier, serving in the papal army against the Turks. He distinguished himself in action, and in 1571, after losing his left hand, joined the Spanish service at Naples. On his return to Spain in 1575 he was taken prisoner by an African corsair, taken to Algiers and sold as a slave. He remained in bondage for 5 years, during which he engaged in several conspiracies to escape, and was finally ransomed by friends in 1580. Thenceforth, he devoted his considerable talents to writing. Cervantes had a rich talent for literature, combining a gift of expression with keen observation. His mature literary production began with *Galatea*, a pastoral novel published in 1585. This work was followed by some 30 plays written for the most part in the 10 years following his marriage, when he required a regular income. After this period he abandoned the drama, and retired to Seville, where he wrote steadily on his *magnus opus*, *DON QUIXOTE*, the first part of which was published in 1605. Cervantes in this work combined his powers of observation with a strain of irony, possibly not since excelled. The underlying purpose of his narrative of the deranged knight was to ridicule the chivalric romances of the Middle Ages by means of parodies. The work won wide applause during the author's lifetime, but the book was pirated, and Cervantes' position did not improve economically. He continued to live in poverty, and remained in comparative obscurity until 1613, when he published *Exemplary Novels*, and the year following, *Journey to Parnassus*. He next produced eight plays, but jealousy and professional envy conspired to cheat him of success. After struggles with creditors and publishers, Cervantes saw publication in 1615 of the second part of *Don Quixote*, the last of his prose published in his lifetime. The novel *Persiles and Sigismunda* appeared posthumously, and showed unmistakable signs of the author's diminishing power. Although his masterpiece had been translated into French and English, Cervantes was known in his own country merely as "old, a soldier, and gentleman, and poor." He died at Madrid, Apr. 23, 1616.

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**CERVERA, PASCUAL CERVERA Y TOPETE** (1839-1909), Spanish admiral, was born in Medina, Sidonia, Spain, Feb. 18, 1839. He was in command of the Spanish fleet in Cuban waters in the Spanish-American War, when it was blockaded in the harbor of Santiago. On July 3, 1898, acting upon peremptory orders and against his conviction, he attempted to escape, but was engaged by the American fleet under Admiral Sampson, at that moment commanded by Schley. His entire fleet was destroyed in a decisive battle. Cervera died April 3, 1909, at Cadiz.

**CESARIAN SECTION.** See OBSTETRICS.

**CESSION**, a mode of acquiring title to territory by means of transfer of territory from one power to another through peaceful purchase, sale, or exchange. The cession is formally celebrated by a treaty which sets forth the location and limits of the territory ceded and the rights of the inhabitants. Examples are the purchase by the United States of Alaska from Russia in 1867 and Louisiana Territory from France in 1803.

**CETACEA**, the scientific name for a super-order of aquatic mammals, the cetaceans, as whales, porpoises and dolphins. Like other mammals they are warm blooded; they breathe air by means of lungs, bear their young alive, and nourish them with milk. Externally they resemble fish, but their flukes are horizontal instead of vertical, as are the tails of fish. Internally they are quite unlike fish. Their front flippers are supported by the bones of a five-fingered hand. Some whales even have the bones of a hind limb (which is lacking) embedded in their flesh. These, and similar vestigial structures, would be inexplicable if we did not know that modern cetaceans were probably descended from land-living ancestors. See also DOLPHIN; GRAMPUS; PORPOISE; RORQUAL; WHALE.

**CETINJE**, capital of the former kingdom of Montenegro, since 1919 part of YUGOSLAVIA, in a pleasant situation among the Black Mountains. Built like a village, it has a Greek Orthodox metropolitan, theater, museum and a marvelous paved road from the port of Cattaro far below. The town grew up around a monastery founded in 1478. The palace and legations have gone to ruin. Taken by the Austrians in 1916, it was occupied by the Serbs at the end of 1918. Pop. 1931, 6,367.

**CETTE.** See SÈRE.

**CETUS** (gen. *Ceti*), the whale, a large constellation, containing, however, only one star of the second magnitude, Beta, which is yellow in color. Its most interesting star is MIRA, a variable star with a period of 330 days. A fourth magnitude star, Tau Ceti, ranks among the nearest stars, being only 10 light years distant. It has a speed of 4 miles per second. Gamma Ceti is an interesting double star. See STAR: *map*.

**CÉVENNES**, a mountain range in the south of France, extending from the mountains of Auvergne to the Alps. Starting at the southern termination of the Lyonnais Mountains, the Cévennes stretch from northeast to southwest to the Canal du Midi, passing through nine departments. The southern section of these mountains contains a number of deeply penetrating fissures and extinct volcanoes. Many rivers have their headwaters in the flanks of the Cévennes, notably the Loire, Lot and Gard. On the average, the range rises to a height between 3,000 and 4,000 ft., the loftiest summits being Mézenc, Lozère, and the Gerbier des Joncs. Following the revocation of the Edict of Nantes, many Protestants sought the Cévennes as a refuge from persecution.

**CEYLON**, a British island in the Indian Ocean, separated from the southern tip of India by the nar-

row and shallow Palk Strait. The island is shaped like a pear, lies between 5° 55' and 9° 55' N. lat., is about 270 mi. long and has an area of 25,332 sq. mi. Pop. 1921, 4,504,549; 1931, 5,312,548. The principal race is the Singhalese, also known as Cingalese or Ceylonese, who came from India and conquered the island in the 6th century, B.C. The Singhalese are Buddhists. Tamils, who are Hindus by religion, inhabit the northern part of the island. There are about 250,000 Mohammedans who are traders, boatmen and fishermen. Descendants of old Portuguese and Dutch settlers, known as Burghers, form a small community. The very primitive hill tribe, Veddas, is rapidly decreasing in numbers.

The center of the southern, broader part of the island is a mountainous region. Adam's Peak (7,420 ft.) is famous for the legend that thence Buddha ascended to heaven leaving in evidence a huge footprint. The small rivers are navigable only by canoes. The part of the island exposed to the northeast monsoon has a hot and dry climate, while the west division, which is open to the southwest monsoon, is temperate and humid.

About 3,000,000 acres are cultivated. The principal crops are rice, tea, coconuts, rubber, cacao and cinnamon. Cattle number 1,500,000, but there are few sheep. The export value of coconut products amounts to over \$25,000,000 yearly. Tea exported in 1928 was nearly 237,000,000 lbs. of which 140,000,000 lbs. was shipped to Great Britain. Plumbago and monazite are the only minerals of commercial importance. Beautiful wood-ebony, satin, rose and other cabinet woods grow abundantly.

The chief towns are COLOMBO, the capital, Kandy, Galle, Anuradhapura and Matara. The Maldivé Islands, about 400 mi. to the southwest, form a dependency of Ceylon. The first European settlers were the Portuguese in 1505. The Dutch followed in the next century and wrested the settlements from them. Coastal settlements of the island have formed part of the British Empire since 1796, being constituted a Crown colony in 1802, and since 1815 the whole island has been British territory. Government is conducted by a governor and two councils. Ceylon is entirely separated from India in all matters of administration.

**CÉZANNE, PAUL** (1839-1906), French post-impressionist painter, was born at Aix in Provence, Jan. 19, 1839. Highly original from the beginning, Cézanne only found his place in art when he came under the influence of Pissaro, at the École Suisse in Paris and followed the lead of Manet and the Impressionists, with whom he exhibited for several years. Dissatisfied however with what he considered lack of depth in their work, he retired in 1879 to Aix and devoted himself in solitude to the working out of his own ideals. He did not achieve recognition until the opening of the century, but his posthumous fame constantly increases. He is now represented by landscapes, portraits and still life paintings in most of the great museums. The secret of Cézanne's art was

his ability completely to "realize" his subject, with respect both to design and color. His use of distinct and almost sculptural planes in painting, together with his use of finely modulated color effects, have furnished the bases for most modern techniques. (See also POST-IMPRESSIONISM and CUBISM.) Cézanne died at Aix, Oct. 23, 1906.

**C. G. S. SYSTEM.** See UNITS, PHYSICAL.

**CHACHALACA** (*Ortalis vetula vetula*), a large semi-arboreal game bird of the curassow family (*Cracidae*) found in southern Texas and northeastern Mexico, named in imitation of its loud call made from treetops at sunrise and sunset. See also CURASSOW.

**CHACMA**, the largest of long-tailed African baboons. This species (*Papio porcarius*), about the size of a mastiff, is that most commonly seen in zoological parks. It is recognized by the absence of a mane, comparatively small callosities, the purplish color of the face, and the dislocated carriage of the tail. Troops of these powerful baboons still roam about in the mountain regions of Cape Colony, occasionally destroying fruit, crops, or ostrich eggs, or killing lambs and kids, but menacing human life only when attacked.

**CHACO CANYON**, a national monument, created March 11, 1907, situated in northwestern New Mexico. The monument comprises about 21,512 acres and contains 18 major ruins which are the finest examples of aboriginal masonry in the entire southwest and represent the zenith of prehistoric pueblo civilization.

Pueblo Bonito, Beautiful Village, is the largest of the ruins. It is an immense semicircular structure covering over 3 acres of ground. Portions of wall structure still standing indicate that it was at least four stories high. Evidences of several periods of building can be seen, and at one time it undoubtedly contained about 800 rooms, 32 kivas or ceremonial chambers and housed approximately 1,200 people. The National Geographic Society, which has done extensive excavating in Chaco Canyon, estimates that Pueblo Bonito was abandoned about 1,000 years ago.

Other ruins here are built along similar lines but are not so large. Chetro measures 440 by 250 ft. and is an exceptionally fine example of the masonic skill of its builders. Some ruins show traces of private houses, and there are extensive remains of irrigations works.

Chaco Canyon is accessible from Thoreau, a town 65 mi. south on the Santa Fé railroad and the National Old Trails Highway.

**CHACONNE**, a Spanish dance, resembling a slow PASSACAGLIA, generally in 3/4 time, or the name of an instrumental composition in which such a movement occurs. It is characterized by repeated phrases set against a ground bass eight bars in length. J. S. Bach's fourth sonata for violin solo is a notable example of the chaconne.

**CHAD or CEADDA, ST.**, Anglo-Saxon Archbishop of York, was born early in the 7th century in England, but was educated in Ireland. He acquired

a great reputation for his holiness and organizing ability. In the absence of St. Wilfrid in France, Chad took his place as Archbishop of York. On the return of St. Wilfrid, Chad was ordained bishop of the Mercians, in which position he served with great devotion and competence until his death in 672 or 673. His day is Mar. 2.

**CHAD, LAKE**, in the Sudan, central Africa, with an estimated area of 10,000 sq. mi. in the dry season. There is obvious evidence that Lake Chad is drying up. Summer inundations, which vary in extent from year to year, are slowly decreasing in amount. The water of the lake is relatively fresh; supposedly because of the enormous growth of aquatic vegetation absorbing the dissolved salts. Tchad is an alternative spelling for the lake.

**CHADRON PARK**, a state park 9 mi. south of Chadron in Dawes Co., Neb., established in 1921. The park, situated in the wooded Pine Ridge region of northwest Nebraska, contains 640 acres of meadows, forests and canyons.

**CHADWICK, GEORGE WHITEFIELD** (1854- ), American music composer, born at Lowell, Mass., Nov. 13, 1854. In 1877-79 he studied at Leipzig and Munich, receiving instruction from Reinecke and Rheinberger. At Leipzig he chose an American subject for his thesis, composing the *Rip van Winkle* overture, which he later conducted at Boston. He was summoned to Boston as professor of harmony at the New England Conservatory, of which he was director during 1897-1930. His works include two symphonies, many choral works, overtures, and several operas.

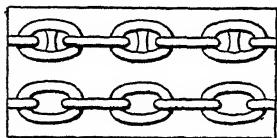
**CHAERONEA**, an ancient Boeotian city near the Cephissus River and the Phocian boundary, the birthplace of PLUTARCH and the scene of two battles of ancient history. Becoming an independent city in the 4th century B.C., it was an outpost against invaders of central Greece. Near it, Philip of Macedon, accompanied by his son, the future ALEXANDER THE GREAT, met the forces of the Athenians, Thebans and Corinthians, and defeated them decisively in 338 B.C., thereby bringing nearly all Greece to her knees. Where the Boeotians were buried a gigantic lion was placed to mark the spot. More than 200 years later, in 86 B.C., SULLA, the Roman general, defeated the forces of Mithridates near the same place. At Kapraena, the modern village on the site of Chaeronea, the remains of one of the most nearly perfect of Greek theaters may be seen. See GREECE: *Ancient History*.

**CHAFER**, in America, a term applied to the leaf-eating beetles of the family *Scarabaeidae*. The larvae are found in rotten wood or in the soil, where they feed on roots of plants. Adults usually eat the leaves of trees, but some also feed upon blossoms and newly-formed fruit. May-beetles or June-bugs, rose-bugs, shining leaf-chafers, the Japanese beetle, rhinoceros beetles and flower beetles, belong to this group.

**CHAFFINCH** (*Fringilla coelebs*), a small songbird of the finch family very common in woods and

about dwellings throughout Europe. It is about the size of an English sparrow. In color the male is a handsome reddish brown on the back, with the wings, forehead and tail largely black, the head gray, the rump green and the underparts rose red. The chaffinch feeds on insects, weed seeds and fruits and nests in bushes or trees, laying 4 to 6 variously marked, greenish-blue eggs. Because of its very sweet song the male is often kept as a cage bird.

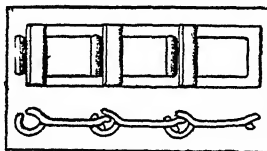
**CHAIN**, a word with two meanings; first, links of metal, connected together. There is a large variety of links, as those designed to transmit power where the chain runs over sprocket wheels, links with buckets attached for elevating materials, and those for raising weights. For raising weights the links may be open or with a stud in the center (called stud links), the latter being largely used



CHAIN LINKS FOR POWER TRANSMISSION

for handling ship's Anchors, the stud preventing the chain from kinking.

Second, in surveying, a measuring instrument called a chain is used. Thus a Gunter's chain, known also as a surveyor's chain, is 66 ft. or 4 rods, consisting of links 7.92 in. This chain is particularly useful in surveying, as 10 square chains equal one acre. There is also an engineer's chain of 100 ft., consisting of links one foot long.



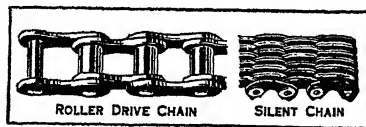
COURTESY LINK-BELT CO.

SQUARE LINK CHAIN

Showing front and side view

### Chains for Power Transmission

have been used for many years, beginning with the old forged link chains which fitted into pockets cast in the wheels over which the chain ran. Next came the open or square link chain, usually made of malleable iron, which ran over SPROCKETS. This was followed by



ROLLER DRIVE CHAIN

SILENT CHAIN

the roller type of chain, built up of hardened steel rollers and steel side links. The so-called silent chain is one of the later developments. These are made up of narrow links usually with projections on one side, although later developments utilize both sides of the chain for driving, as in some front drives of automobiles. All three types of chains are still in general use in modified forms.

**CHAIN BANKING**, a form of multiple banking which consists in the operation of a group of independently incorporated banking institutions which are controlled through stock ownership by an individual or group of individuals, or which have a community of interest. This type of banking should be distinguished from **BRANCH BANKING** in which there is only

one corporation, each branch being a legal part of the head office. It is also different from group banking which is a term now generally used to refer to that type in which a **HOLDING CORPORATION** is formed. The holding company buys control of the independent banks through an exchange of its own Stock or by purchase for CASH. The stock in the individual banks is owned by the holding company. In the case of group banking there is frequently present a large banking institution around which all the smaller banks are grouped.

The purpose of individuals forming or building up a so-called chain of banks varies considerably. In some cases the individual owner of the stock is interested in the income which he derives in the form of **DIVIDENDS** on the stock. Under such conditions the owner is not interested in participating in the management so long as the dividends are paid. In other cases the owners are the controlling factor in the management and use the banks as a source of funds to finance their own business. Under such circumstances, it becomes dangerous for the depositors, since the funds may be used to finance undesirable business of the owners. In other cases the chains have been built up by an individual or group without purchasing control. This may be done on a contract basis, the promoters agreeing to perform some investment service for each individual bank, on condition that each bank pay a service fee.

In most cases the banks included in a chain are small banks. The large amount of capital required to buy and control a big bank makes it difficult to bring them into a chain. This offers an element of weakness. Group banking as now defined has a distinct advantage over chain banking in this connection. The holding company is usually, through its power of raising capital funds, likely to be able to command much larger volume of funds, and may, therefore, include large banks as well as small banks. Some of the group systems have very large banks, examples of which are seen in the case of Marine Midland Corporation in New York and the Northwest Bancorporation in Minneapolis. These two groups have in each case a large commercial bank around which all the smaller units are grouped.

There is nothing inherently wrong in the ownership and control of several banking units by one individual or by a group of individuals. The most serious objections to chain banking are that it is difficult to supervise, if in undesirable hands; that the bank may be filled with bad paper and that the funds may be used for the interest of the owners rather than for the good of the depositors and the community. Group banking has been developing rapidly in the United States, whereas chain banking has been steadily losing ground. Especially is this true since the failure of Witham Chain in Georgia in 1926. See also **BRANCH BANKING**. J. M. C.

**CHAIN FERN** (*Woodwardia*), a group of large handsome ferns, so named because the spore-bearing structures (sori) are borne in chainlike rows on the



backs of the leaves. Seven species are known, widely diffused in temperate and warm regions. The great chain fern (*W. radicans*), with long-stalked leaves standing sometimes 6 ft. high, grows in California and Arizona. The smaller Virginia chain fern (*W. virginica*) and the net-veined chain fern (*W. areolata*), are found in eastern North America.

**CHAIN-SNAKE**, called also king snake, popular names for a species (*Ophibolus getulus*) of harmless snake, widely distributed in the United States, and found also in parts of Mexico. The color variety from the East is blackish, with yellow markings forming a chainlike pattern on the back and sides. Another variety, called the thunder snake, found in the South, is greenish with white markings, and still another, Boyles king snake, from the Southwest, has very large cream-colored stripes. The chain-snake is a powerful constrictor, 4 to 5 ft. long, and can attack and kill large poisonous snakes, to whose venom it is immune.

**CHAIN STORE**, a group of retail stores under one ownership and operated under one management. Opinion differs as to the number of stores which make a chain store system. In the grocery field the full benefits of the chain store method of distribution are not enjoyed until an organization numbers from 50 to 200 units.

While the chain idea has been known and used in merchandising for centuries, notable examples being the house of the Fuggers in the 15th century, the Mitsui organization in Japan originating at about the same time and the Hudson Bay Company formed in 1670, its true development as a modern retailing institution began with the formation of the Great Atlantic and Pacific Tea Company in 1858, followed in 1872 by the Jones Brothers Tea Company and in 1879 by the F. W. Woolworth Company. In 1930 the Great Atlantic and Pacific Tea Company operated about 15,000 stores in all parts of the country and its annual sales were \$1,062,296,331. In 1929 the Woolworth Company included 2,100 stores and its total annual sales in 1930 were \$229,288,552.

In 1930 it was estimated that chain stores constituted from 15 to 20% of the total number of retail establishments in the United States and handled about 30% of the country's total retail sales volume. During the decade 1920-1930 the chain method of retailing enjoyed a remarkable expansion in number of units, volume of sales, and lines of goods sold. During the latter half of the decade several chains of DEPARTMENT STORES were formed.

The outstanding advantages which the chain store enjoys over rival retailing institutions are superior buying power due to the large amounts in which it is able to purchase and standardization of equipment, of stocks, and of methods of control and operation.

The chain store is severely criticized by independent merchants. In some states this opposition has resulted in hostile legislation, which emphasizes the chain's lack of close touch and identity with the communities in which its units operate. So highly

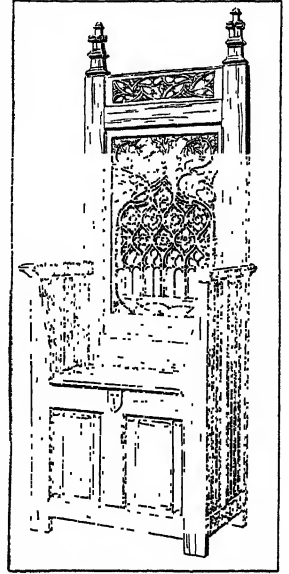
standardized an institution cannot readily adjust its stocks and its methods of operation to local tastes and habits, and also experiences difficulty in finding capable and loyal managers for its unit stores. Moreover, the cutting down of prices chokes competition and limits the profits of independent stores. R. S. A.

**CHAIR**, a movable single seat with a back. One of the most common articles of furniture to-day, yet before 1500 the chair was a rarity, reserved for kings and lords; lesser folk sat on chests, benches and stools. Nowadays chairs are classified according to material, purpose or structure. But in the history of furniture interest in the chair centers on the maker, the period and the style of art.

One of the most ancient chairs surviving is the 6th century Byzantine chair, called the Chair of St. Peter, now in St. Peter's at Rome. But pictures and carvings prove that the ancient Egyptians, as well as the Greeks and Romans, had sumptuous chairs. The

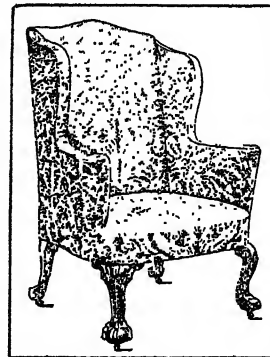
Roman *curle* or X-shaped chair was like the modern folding chair in form. The English Coronation Chair in Westminster Abbey is of Gothic design, dating from the 13th century, at which time most chairs had a solid back and sides, and many had a locker under the seat, suggesting the probable evolution of this type from the CHEST. The decoration then consisted of carving, inlaying, painting, gilding and turning. Padded upholstery, with velvet, damask, fringe and tassels, originated in the Italian Renaissance, only loose cushions and textile drapes having been used before. In the Jacobean period chairs without arms

were first made in England, cane seats and backs were designed, and a more open structure prevailed, with light legs strengthened by ornamental stretchers. Charles II at the Restoration introduced the showy French styles, noted for their veneer, marquetry and lacquer and their elaborate gilded carving and luxurious upholstery. Queen Anne's style was simpler. But the age of chairs was the Georgian period, when



COURTESY M. M. OF ART

FRENCH CHAIR OF THE 15TH CENTURY IN FLAMBOYANT GOTHIC DESIGN

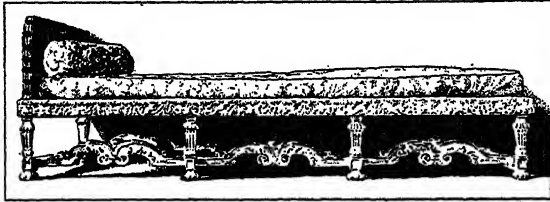


COURTESY M. M. OF ART

AMERICAN WING CHAIR, COLONIAL PERIOD, SHOWING CHIPPENDALE INFLUENCE

mahogany came into common use and THOMAS CHIP-PENDALE, winning fame as the incomparable craftsman, was followed by ROBERT ADAM, GEORGE HEPPLEWHITE and THOMAS SHERATON. These four cabinet-makers have probably never been surpassed. Their work was enthusiastically copied in early American furniture, of which the best known designer was DUNCAN PHYFE.

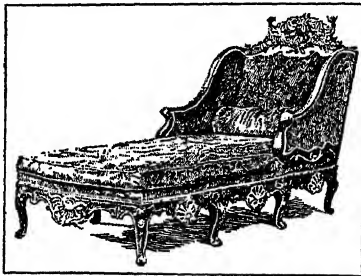
**CHAISE LONGUE**, a French term for an elongated chair used for reclining on in the day time, and



FRENCH 17TH CENTURY CHAISE LONGUE OF OAK, CARVED AND GILDED

*In the Musée des Arts Décoratifs, Paris*

introduced in the régime of Louis XIV. The slanting chair-back of this piece provided the headrest; back and seat were luxuriously upholstered. The frame, elaborately carved, painted or gilded, was often sup-



COURTESY M. M. OF ART

FRENCH CHAISE LONGUE OF CARVED WALNUT. SCHOOL OF TOULON, 18TH CENTURY

ported on ten legs. Some recent models of the chaise longue are made of wickerwork, or are cane-seated, and have adjustable footrests.

**CHALCEDON, COUNCIL OF.** The Fourth General Council, held at Chalcedon, in Asia Minor, in 451, was summoned to deal with one phase of the Christological controversy, the prolonged and wearisome disputes concerning the nature and person of Christ. An Eastern monk, named Eutyches, zealous, devout, but seemingly unlearned in theology, had been charged with teaching a false doctrine, called Eutychianism after his name—in reality a form of the Monophysite heresy—and this teaching had been upheld by the so-called Robber Synod of Ephesus in 449. Of the 600 members of the Council all save the papal legates and two African bishops were from the East; but the decrees of the Council were accepted by the universal Church and it is counted as one of the Ecumenical or General Councils. It was presided over by the imperial representatives; in their absence, by the papal legates. On the main point at issue, the

Council determined that Christ is one person with two natures, the human and the divine, united in such wise that his mother is rightly designated *Theotokos*—the Mother of God, in accordance with the decision of the Council of Ephesus, 431. This was the Western doctrine, set forth by the Roman Church.

Roman Catholic controversialists advance the decision of the Council of Chalcedon and the part played by the papal legates as evidence of the acceptance of papal supremacy throughout the whole Church in the 5th century. Their opponents, on the other hand, emphasize the fact that the presidency of the Council was held by the emperor's representatives, and claim that one of its canons, passed in the absence of the papal legates, declared the See of Constantinople of equal authority with the See of Rome. A. H. S.

**CHALCEDONY**, a variety of QUARTZ with a wax-like luster, translucent to transparent, which occurs widely and in many different forms and colors. The cloudy, pale blue chalcedony is used as a semiprecious stone in rings and necklaces, as is the clear to cloudy red variety known as CARNELIAN. Other forms of value as semiprecious stones are CHRYSOPRASE, prase, plasma and heliotrope or BLOODSTONE, which are green in color, the last with red spots of JASPER. Also AGATE, ONYX, SARDONYX, which are banded, and the opaque red, green or yellow form, jasper. Their common characteristic is that they are cryptocrystalline, showing no crystal form except under the microscope. The colors are due to impurities. One crystalline form of silica is included in chalcedony, however, occurring in concretionary masses of concentric structure with radiating fibers.

Other forms of chalcedony are usually white, grayish, brown to black, and opaque. FLINT, chert and hornstone are often found as nodules or layers in limestone, and provided early man with material for weapons and implements. The touchstone, or basanite, of the ancient was a black flint used to test the purity of gold alloys by the color of the streak they left when rubbed on it. Chalcedony, like OPAL, often forms the petrifying material of fossil woods.

Chalcedony occurs principally in cavities in older rocks where it has been deposited by infiltrating waters, in sedimentary beds, and in certain ore deposits. It may be the product of the WEATHERING of other rocks, or may be derived from hot, ascending solutions.

Fine specimens of chalcedony come from Iceland, CARNELIANS and AGATE from Arabia, India, Brazil, chrysoprase from Silesia, plasma from India and China, bloodstone from Tartary and Siberia, and fine specimens of agatized wood from the petrified forest in Arizona. See also GEM STONES. S. F. K.

**CHALCIS-FLY**, any one of thousands of species of small hymenopterous insects of the family *Chalcididae*. One species (*Bruchopphagus funebris*) destroys ripening clover and alfalfa seed. Another, the joint worm (*Isoma hordei*), makes growing grain stems woody; some are found in galls made by gall

flies which they resemble in structure. But the great majority are parasitic on other insects and therefore largely of economic importance. Some of these live externally on maggots and caterpillars; others wholly within their hosts, and many inside the eggs of other insects. Among the countless destructive insects they control are tent caterpillar, cabbage worm, cotton worm and scale bugs.

**CHALCOCITE**, an important and rich ORE of copper, also called copper glance, which cuts easily and is dark lead gray and metallic in appearance; it tarnishes black or dark green. It is a copper sulphide, usually occurring massive or granular, or as a sooty powder, but also as ORTHORHOMBIC crystals. Chalcocite, ordinarily a secondary mineral derived from the WEATHERING of other copper compounds, is found in sedimentary beds of the Colorado Plateau and in northern Rhodesia, and in veins in Cornwall, South America, Mexico, Canada and the western United States. It is probably a primary mineral at Butte, Mont. See also ORE DEPOSITS.

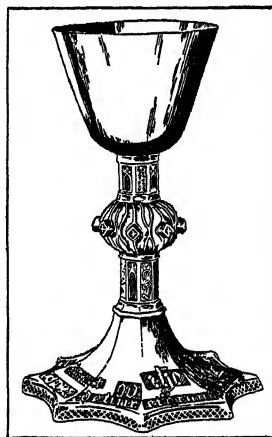
**CHALCOPYRITE**, a widespread and important ORE of copper, brassy yellow and metallic in appearance. Other names for it are copper pyrites, pyritous copper, fools' gold, yellow copper ore and, because of its iridescent tarnish, peacock ore, a term also applied to BORNITE. It is a copper iron sulphide but contains less copper than bornite, and crystallizes in the TETRAGONAL SYSTEM. Chalcopyrite occurs in vein deposits formed at high temperatures, often accompanied by TOURMALINE. This type is common in Chile. In Cornwall it occurs with tin. In North America chalcopyrite deposits are mostly of the contact metamorphic type, where intrusions of igneous rock have introduced this, with other minerals, into preexisting formations, commonly LIMESTONE. Noteworthy examples are found in Arizona, New Mexico and Mexico, and in Australia, Japan and Korea. A third type results from local concentrations within the molten, intruding rock, exemplified by the nickel-copper deposits near Sudbury, Canada. See also ORE DEPOSITS; METAMORPHISM; MINERALOGY; CRYSTALLOGRAPHY.

**CHALDEA**, or **CHALDEANS**, in a wide sense used as the equivalent of BABYLONIA and the Babylonians. In a narrow sense Chaldea referred to a province of Babylonia. The Chaldeans were apparently a Semitic people distinct from the Arabs and the Aramaeans and inhabiting the fertile region between the Tigris and the Euphrates, known to-day as the Mesopotamian Valley. Although originally racially distinct from the Babylonians, the Chaldeans in the course of centuries became so thoroughly amalgamated with them that in Biblical times they were thought of as one race. In later centuries the name "Chaldeans" came to be applied to the priestly class among the Babylonians and is so employed in the Biblical Book of Daniel and by classical writers such as Herodotus. In this sense the name was in time still further restricted to the meaning of astrologer, wise man or magician and is so used in many ancient works on astrology and divination.

**CHALFONT ST. GILES**, a village 25 mi. northwest of London, in Buckinghamshire, England, containing the cottage in which the poet JOHN MILTON finished *PARADISE LOST* and probably began *Paradise Regained*. The poet lived in his "pretty little box"—whither he had fled to escape the plague—between 1565 and 1566. His cottage is now national property. About 2 mi. southwest is the Quakers' cemetery in which WILLIAM PENN is buried.

**CHALIAPIN, FEODOR** (1873- ), Russian basso, was born at Kazan, Feb. 11, 1873. In 1890-92 he was a member of a traveling opera troupe, which he left in 1893 to study with Usatov at Tiflis. The following year he appeared in minor parts with the Petrograd Summer Opera, and in 1896 was engaged by the Privat Opera at Moscow. His remarkable voice and histrionic ability were first widely appreciated outside Russia when he appeared at the Metropolitan Opera, New York, in 1906-07, making his American debut in *Boris Godounov*. In 1913 he appeared at Covent Garden, London, in *La Khovantchina* and *Ivan the Terrible*. He returned to the United States in 1922, joining the Chicago Civic Opera Co. the following year. Chaliapin has since appeared in opera, chiefly in Russian music-drama, in the chief cities of the world. His celebrated rôles have been in *Boris Godounov*, *Mefistofele*, *Don Giovanni*, *Ivan the Terrible* and *The Barber of Seville*.

**CHALICE**, a drinking vessel in the form of a goblet with a nodular stem. The first Christians adopted the chalice from the Jews and Romans and it became the cup used in the Communion service. As the congregations grew, a second chalice was employed, which was provided with handles. The first were made of wood, then of glass, earthenware, bronze, marble, horn, tin, copper, silver or gold, and sometimes of onyx and ivory. From the beginning they were ornamented in many ways and set with jewels. The richest and most artistic chalices were made in the Gothic and Renaissance eras.



COURTESY M. M. OF ART  
SILVER GILT CHALICE, POSSIBLY  
OF IRISH MAKE (1494)  
Original in National Museum,  
Dublin

**CHALK**, a soft, white, friable rock, largely made up of fine calcareous powder. This consists of tiny shells of microscopic marine animals, the foraminifera with minute fragments of the calcareous shells of larger organisms and bits of siliceous skeletons and shells of other marine life. In the main, however, chalk is very nearly pure CALCITE, calcium carbonate. When impurities are present, the color may be buff, gray or flesh color. The siliceous material often concentrates into nodules of FLINT or chert, commonly found in certain chalk beds.

Fossils occurring in chalk indicate that it is laid down in warm and shallow seas, clear and free of land debris. The large amount deposited during one of the geological periods explains the application of the name Cretaceous to that period. The word is derived from the Latin *creta*, applied to white clay and chalk by the Romans. Extensive chalk deposits are found in England, forming the well-known cliffs of Dover, and in Denmark and France. The United States is the principal consumer of the chalk from these countries, as the deposits in Nebraska, Arkansas and Texas have not been commercially exploited to an appreciable extent.

Chalk is used for making whiting, blackboard chalks, as a filler in rubber, and as a component of paint and putty. It is also used for polishing powders. The waste material of LIMESTONE quarries is sometimes used as a substitute for chalk in the manufacture of whiting.

**CHALK PLATE ENGRAVING**, a simple and inexpensive method of making relief printing plates of diagrams, outline drawings and coarse pen-sketches, extensively used in newspaper plants. A thin layer of a chalk preparation is spread over a smooth steel plate and the picture or design is cut through the chalk with a fine pointed tool. This engraved surface is used as a matrix for casting a stereotype block on which the engraved lines stand in relief. The skill of the engraver largely determines the success of the method as the drawing is done practically free-hand. The process is sometimes called the Hoke Chalk Plate after the name of the patentee.

**CHALLENGER EXPEDITION**, an expedition sent out by the British government in 1873-76 for the purpose of deep-sea exploration. The main object was to establish the depths and general contours of the ocean basins, and to study deep-sea life. The expedition was named after the vessel employed, H.M.S. Challenger.

**CHALMETTE NATIONAL MONUMENT**, a tract of 17 acres on the Mississippi River in southeastern Louisiana a few miles below New Orleans. The Battle of New Orleans, the last engagement of the War of 1812 and an American victory, was fought here Jan. 8, 1815. The outcome of the war was unaffected by this battle, however, as it was fought after the signing of the treaty of Ghent and before the news reached Washington.

**CHÂLONS, BATTLE OF**, 451, the engagement of the Romans and Visigoths, led by Aetius and Theodoric II, the Visigoth, and the Huns, led by Attila, who were attempting to overrun Gaul. Defeated by Aetius in his attempt to capture Orléans, Attila moved toward Châlons-sur-Marne, where he arranged his troops for battle on the plains then known as Campi Catalaunici. When the battle began, Attila was able to hold the center lines; but both of his flanks were severely beaten in the fighting, and he was compelled to retire. There were great losses on both sides, and Theodoric was killed. By not following up his victory Aetius allowed Attila

and the Huns to escape and plunder Gaul and northern Italy.

**CHÂLONS-SUR-MARNE**, a city in northeastern France, capital of the department of Marne, situated about 105 mi. east of Paris. Châlons was occupied by the German forces for several days in Sept. 1914, and was later bombarded. The town has a good Gothic cathedral, mainly of the 13th century. It is an army headquarters, has a trade school and is an important center for champagne. Brewing is the chief of the city's varied industries. Pop. 1931, 32,307.

**CHÂLON-SUR-SAÔNE**, an industrial and grain-trading city in the department of Saône-et-Loire, eastern central France. It belonged to Burgundy from 1237 to 1477, and its principal church is a good example of Burgundian architecture, mainly of the 13th century. Copper and iron form the bases of its chief industries, and a branch of the Le Creusot engineering works is situated here. Pop. 1931, 32,533.

**CHAMAELEON** (gen. *Chamaeleontis*), a small constellation of faint stars near the south celestial pole. See STAR: map.

**CHAMBERLAIN, JOSEPH** (1836-1914), British statesman and Liberal leader, was born at London, July 8, 1836. His education was received at the University College School. Chamberlain's father was a screw manufacturer. In 1852 Joseph started work in the London office and by 1874 he had become wealthy. In 1876 he was elected to Parliament, the first business man, not university-trained, to attain an influential position in British public affairs. Between 1880 and 1886 Chamberlain was a member of Gladstone's cabinet, and in 1891 became leader of the Liberal-Unionists. He was appointed colonial secretary in 1895, and in this office he suffered somewhat at the hands of critics of British policy during the BOER WAR. The Unionist party was defeated in 1906, and Chamberlain retired after thirty years of public life. He died at Birmingham, July 2, 1914.

**CHAMBERLAIN, SIR JOSEPH AUSTEN** (1863- ), English statesman, was born at Birmingham Oct. 16, 1863, the son of Joseph Chamberlain. He was educated at Rugby, Cambridge, Paris and Berlin, and was elected to Parliament in 1892 for West Worcestershire. In 1914 he became a member for East Birmingham. He has great ability and powers of debate. He was chancellor of the exchequer in 1903, a member of the cabinet in 1915, secretary of state for India, resigning in 1917; a member of the war cabinet in 1918; prominent in the founding of the Irish Free State, and foreign secretary, 1924. A leading member of the Conservative party he was again made chancellor of the exchequer after the victory of the Coalition ministry in 1931. In 1925 he received the Order of the Garter.

**CHAMBERLIN, CLARENCE DUNCAN** (1893- ), American aviator, was born at Denison, Ia., Nov. 11, 1893. He attended the public schools there, enrolled at Denison Normal and Business College in 1911, and at Iowa State College from 1912-14.

In 1917, he joined the Signal Reserve Corps at Fort Omaha, Neb., and was transferred in March to the School of Military Aeronautics at Champaign, Ill., where he was commissioned on July 15, 1918. In Apr. 1927, with Acosta in the monoplane *Columbia*, at Curtiss Field, L.I., he gained the then world's endurance record of 51 hrs. 11 min. 25 sec. In 1927, accompanied by C. A. Levine, then owner of the *Columbia*, Chamberlin took off from Roosevelt Field, L.I., on June 4, and flying 4,000 mi. in 43 hrs., landed at Mansfeldt, Germany, on June 6, to score the first New York to Germany flight. The fliers were accorded official and popular receptions in Germany. Chamberlin was the first aviator to take off from the deck of a passenger liner, rising from the *Leviathan* 100 mi. at sea, on July 31, 1927, in a test to speed important mails between European ports and the United States. With C. B. Allen, he wrote *Record Flights*, an autobiography, in 1928. Chamberlin's many awards include the Distinguished Flying Cross and the New York Medal of Honor.

**CHAMBERLIN, THOMAS CHROWDER** (1843-1928), American educator and geologist, was born in Mattoon, Ill., Sept. 25, 1843. He graduated from Beloit College in 1866, and returned to it as professor of geology in 1873. Five years later he made a study of the glaciers of Switzerland and became known as the leading American glacialist. Chamberlin was made head of the Division of Glacial Geology in the United States Geological Survey in Washington, but resigned in 1887 to become president of the University of Wisconsin. In 1892 he was appointed head of the geological department at the University of Chicago. He died in Chicago, Nov. 15, 1928.

**CHAMBER MUSIC**, a term originally applied to music not designed for the church or the theater, which in present-day music has acquired the more limited meaning of instrumental music designed for a small hall or chamber, especially music for a small number of instruments such as the string quartet. Less pretentious externally than symphonic music, it is not necessarily less profound than music scored for a large number of instruments. Chamber music has attracted the genius of all the masters who have repeatedly availed themselves of its modest means to express their highest eloquence.

**CHAMBER OF COMMERCE.** Chambers of commerce include two types of business organizations: first, those formed primarily for the protection of commercial relationships and the promotion of trade; and second, those formed for the general advancement of community interests. The former type existed many centuries ago in Europe and is still represented, for example, by such organizations as the American chambers of commerce established in various foreign countries. The latter is a more recent development and is typified by the community organizations found in almost every city and town of the United States.

As an agency for the promotion of community in-

terests the local chambers of commerce in this country have a wide range of activities. Particular attention is usually given to the dissemination of information in regard to the advantages of the community from an industrial viewpoint as a means of attracting new enterprises. The local organizations also interest themselves in any question relating to local civic welfare, including the development of parks and playgrounds, the improvement of transportation facilities and the analysis of local governmental expenditures.

The Chamber of Commerce of the United States is a federation of local chambers of commerce and boards of trade, but also comprises in its membership both individuals and a number of national trade associations. Its activities include the dissemination of commercial information among its members, but it functions primarily as an agency for the coordination and expression of the opinions of business men on questions affecting the financial, commercial, civic and industrial interests of the country at large.

The International Chamber of Commerce was organized in 1919 along similar lines, being, however, international in scope. Its program includes the removal of the economic causes of international conflict, the development of greater uniformity in commercial practices and in the laws governing business transactions, and the expression of the views of the business world on those questions which affect international trade relations. M. A.

**CHAMBER OF DEPUTIES.** See RIGHT PARTIES; SCRUTIN DE LISTE.

**CHAMBERS, CHARLES HADDON** (1860-1921), British dramatist, was born at Stanmore, New South Wales, Australia, Apr. 22, 1860. He settled in England about 1880 and became a popular playwright. His first play, *One of Them*, was produced in 1886 and was followed by a great number of sentimental comedies of manners, including *The Open Gate*, *Captain Swift*, *The Golden Silence* and *The Impossible Woman*. Chambers died in London, Mar. 28, 1921.

**CHAMBERS, ROBERT WILLIAM** (1865- ), American novelist, was born in Brooklyn, N.Y., May 26, 1865. He studied art in Paris in 1886-93 and worked as an illustrator for *Life* and *Vogue* before beginning to write. He produced a long list of the popular, glamorously romantic type of novel, many of which have historical settings. Among Chambers's works are *The Maker of Moons*, *The Hidden Children*, *The Firing Line*, *The Danger Mark*, *The Restless Sex*, *The Fighting Chance*, *The Common Law*, *The Rake and the Hussy* and *The Painted Minx*, 1931.

**CHAMBERSBURG**, a borough and the county seat of Franklin Co. in the Cumberland Valley of the Blue Ridge Mountains, Pa., about 50 mi. southwest of Harrisburg; it is served by the Pennsylvania and Western Maryland railways and motor bus lines. Industries include grain elevators and manufactures of hydraulic machinery and steam hammers. In 1929 the value of manufactures was about \$8,000,000; the



retail trade amounted to \$8,615,657. Caledonia Park, a state forest preserve, is in the vicinity. Wilson College, a Presbyterian institution for women, chartered in 1860, is situated here, and also Penn Hall, a preparatory school for girls.

Chambersburg was founded in 1730 by Benjamin Chambers, who later built a fort for defense against the Indians. It was the scene of General Lee's maneuvers previous to Gettysburg and was the only town north of the Mason and Dixon line to be burned during the Civil War. President James Buchanan was born in the vicinity. Pop. 1920, 13,171; 1930, 13,788; 95% were native whites.

**CHAMELEON**, a name applied to more than one group of lizards. The true chameleons (*Chamaeleonidae*) are found from Madagascar through Africa to India and Ceylon, but they are only abundant in Africa and Madagascar. The ability of the chameleon to change color is but one of its peculiarities. It is unique among lizards in its remarkable tongue, its opposable, grasping digits, and its independently movable, bulging eyes. In addition, the tail is prehensile and the body flattened vertically. These characters, together with others of a more technical nature, cause some herpetologists to set the chameleons off as a separate suborder, *Rhoptoglossa*. Slow and deliberate in bodily movements, chameleons are, nevertheless, able to project the long, sticky tongue with great speed to secure the necessary food.

In the United States, the name chameleon has become attached to a small iguanid lizard of the southern states, *Anolis carolinensis*, that, together with its many allies, constitutes a large, widely-distributed New World genus. The true chameleon bears little or no real resemblance to its New World namesake, even though both possess the ability to change color.

C. H. P.

**CHAMFORT, SEBASTIAN ROCH NICHOLAS** (1741-94), French epigrammist, was born in Auvergne in 1741, the son of a grocer. For years he lived on people who were charmed by his wit and brilliant conversation and was finally given a pension by the court of Louis XVI. Because court life was not congenial with his Bohemian nature he left it and joined the Revolutionists in 1791. Under the reign of Marat and Robespierre his open criticism of the Convention brought imprisonment. Chamfort died in Paris, Apr. 13, 1794.

**CHAMINADE, CÉCILE** (1861- ), French music composer and pianist, was born at Paris, Aug. 8, 1861. In 1879, after studying with Benjamin Godard, she made a successful début as a pianist. She composed much light piano music and many melodious songs; the *Scarf Dance* and *The Little Silver Ring* are well-known examples of each form. More ambitious efforts include the orchestral suites *Concertstück* and *Les Amazones*, a ballet *Callirhoë*, produced at Marseilles in 1888, and a comic-opera, *La Sévillane*.

**CHAMISAL**, the name given to a distinct zone of shrubby vegetation found on mountain slopes in California between the lower foothills and the yellow pine

belt. It is composed of an almost pure growth of chamise (*Adenostoma fasciculatum*), an evergreen shrub of the rose family, growing from 2 to 10 ft. high, with heathlike, somewhat resinous foliage and minute white flowers in crowded clusters.

**CHAMISSO, ADELBERT VON** (1781-1838), German poet and naturalist, known also as Louis Charles Adelaide de Chamisso, was born in Champagne, France, in 1781. In 1790 the family removed to Berlin, where Chamisso became a page to the Queen of Prussia and mastered the German language in which he wrote. In 1813 he published Peter Schlemihl, the story of a man who lost his shadow; this book was widely translated and brought fame to the author. In 1815 Count Romanzoff selected Chamisso to accompany as botanist the Russian ship *Rurik* on its scientific voyage around the world. Upon his return Chamisso became custodian of the Berlin Botanical Gardens. His best known poems, *Frauen-liebe und-leben*, were published in 1830. Chamisso died in Berlin, Aug. 21, 1838.

**CHAMOIS** (*Rupicapra tragus*), a ruminant intermediate between the antelope and the goat, inhabiting the high mountains of southern Europe and western Asia. Excessive hunting has greatly reduced its formerly large numbers, especially in the Swiss Alps, where it is now preserved by game laws. The chamois is about the size of a well-grown goat, but rather more gracefully proportioned, with a longer neck and shorter body. The black horns rise straight from the forehead to approximately 7 in. and curve back in a hook at the tip. In the different localities the color varies between brown and gray, but all chamois are alike in taking on a winter and a summer coat, in having dark and light face markings, a dark stripe down the back, and a short, black tail.

In summer the chamois ascends to the snow-line; in winter it comes down to the upland forests. Mountain herbs are its chief food, varied, in winter, with young shoots of pines. For agility the chamois is unmatched. Its sight, scent and hearing, too, are extraordinarily keen. These qualities, combined with its wariness and the inaccessibility of the places to which it bounds, make the hunting of it an extremely difficult sport. One member of the flock is always on the watch to announce danger by a whistling sound, though the ordinary cry is a bleat. The flesh



FROM JEPSON, MAN. FL. PLANTS CALIF. COPYRIGHT

CHAMISAL  
Flowering branchlet and single flower

of the chamois is prized for eating. The skin gave the name to the famous "shammy," a washable leather, now also obtained from the hide of other animals.

**CHAMPAGNE**, a medieval province of France, now divided into the departments of Ardennes, Aube, Marne, Haute Marne and parts of others. The region, which includes such important centers as Rheims, Chalons and Troyes, consists of fertile plains and rolling hills and is drained by the Seine River, and its northern tributary, the Marne. It early acquired renown for its wines and, especially in the 12th and 13th centuries, was famous for its fairs, which were six in number. Champagne was a particularly popular fair ground since it lay on the routes of traffic between France, Italy, Flanders and the countries of Germany.

The Gallic inhabitants of the Champagne area were subjugated by Caesar and remained more or less under Roman control until conquered by the Franks. During the time of the Merovingians it was organized into the Duchy of Champagne and assigned to one Loup, 581. The history of Champagne under Loup and his 7th- and 8th-century successors is most obscure, but under Charlemagne the city of Troyes was amalgamated with the duchy and became its capital. Thereafter the duchy was rapidly enlarged through the incorporation of surrounding areas, and it soon came to be known as Champagne and Brie. In 854 Eudes de France, son of Robert the Strong, became count in Champagne, and in 923 the husband of his niece Hildebrand, Herbert de Vermandois, became the first Count of Champagne. This line, however, died out within a century, and in 1019 Champagne came into the possession of the Counts of Blois through the person of Count Odo. Perhaps the most distinguished member of this line was Theobald IV, called "le Chansonier," who ruled the countship from 1201-54, and who achieved fame as poet, singer, fighter and administrator.

Champagne eventually fell to the Crown of France by the marriage, 1284, of Joan, daughter of the last Count of Champagne, Henry III, the Fat, to the heir presumptive Philip, who later became King Philip IV, the Handsome. In 1361 Champagne was definitely incorporated as a province of France. During the World War the Champagne area was the scene of a number of hard-fought campaigns. W. C. L.

See H. d'Arbois de Jubainville, *Histoire des ducs et comtes de Champagne*, 1859-69.

**CHAMPAIGN**, a city of Champaign Co., Ill., 35 mi. west of Danville and 50 mi. northeast of Decatur. The Illinois Central, the Big Four and the Wabash railroads, and an airport serve the city. Champaign and URBANA, a smaller city to the east, are called twin cities and unite as one community in their public utilities and civic organizations, though maintaining separate governments. Urbana is the county seat, Champaign, with small manufacturing, the business section. In 1929 the value of the factory output was about \$5,000,000; the retail trade amounted

to \$18,374,682. The agricultural district produces corn, wheat, and soy beans. Champaign shares with Urbana the campus of the University of Illinois. The city was founded in 1854 and incorporated in 1860. Pop. 1920, 15,873; 1930, 20,348.

**CHAMPLAIN, SAMUEL DE** (1567-1635), French explorer, colonizer and first governor of New France, was born at Brouage. He was for some time in the forces of HENRY IV. In 1603 he accompanied an expedition to Canada, where he made observations along the St. Lawrence as far as Montreal. The next year he entered the service of the Sieur DE MONTS, exploring the New England coast line and making a settlement at Port Royal, the modern Annapolis, N.S. In 1608 Champlain founded the city of Quebec. In 1609 he discovered Lake Champlain while leading the Algonquins and Hurons against the Iroquois, whom he defeated near Ticonderoga. With this battle began the series of IROQUOIS-FRENCH WARS. Two years later he founded Mont Royal, and on his return to France was made lieutenant-governor of New France. In 1613, to investigate the existence of a northwest passage, he made further explorations along the Ottawa River. Two years later he returned to Quebec, and was appointed a member of the Company of New France by Richelieu. In 1629, when Quebec fell into English hands, he was captured by the British, but on the restoration of Canada to the French in 1633 regained his position in New France. He died in 1635.

**CHAMPLAIN, LAKE**, a long narrow body of water, forming the northernmost boundary between New York State and Vermont. It is very irregular in form, being about 12 mi. wide at Burlington, Vt., its widest place, and only about  $\frac{1}{4}$  mi. at its southern end. The mean level of its water is 95 ft. above the tide. The water has an average depth of 600 ft., its surface area is about 436 sq. mi. and its watershed covers 7,900 sq. mi. The Lamoille and Winooski rivers enter the lake from the east and it drains through Richelieu River into the St. Lawrence. Its basin is rugged and mountainous with very little depth of soil except in the stream valleys. It is distinguished for its picturesque beauty and for its many historic landmarks and associations. The first naval battle of the Revolution was fought on Lake Champlain between forces led by Benedict Arnold and Captain Pringle. The French explorer, Champlain, for whom the lake is named, discovered it in 1609.

**CHAMPOLLION, JEAN FRANÇOIS** (1790-1832), French Egyptologist, was born at Figeac, Dec. 23, 1790. The founder of Egyptology, his researches have given students their chief knowledge of the method of interpreting Egyptian hieroglyphics. When a mere youth he attracted attention by his original scholarship in the field of Egyptology, and in 1809 he became professor of history in the Lycée of Grenoble, deciphering his first hieroglyphics in 1821. He was appointed curator of the Egyptian museum in the Louvre, Paris, was the leader of a scientific expedition to Egypt in 1828, and in 1831

was made professor of the chair of Egyptian antiquities, a position especially created for him in the College de France. He was the author of several books on Egypt and its monuments, and an *Egyptian Grammar*. He died in Paris in 1832.

**CHANCELLORSVILLE, BATTLE OF**, May 2-4, 1863, an engagement of the CIVIL WAR, which resulted in an important Confederate victory. After the disastrous BATTLE OF FREDERICKSBURG, Burnside was replaced in command of the Union Army of the Potomac by Gen. Hooker. With a reorganized army of 130,000 men, in the middle of April Hooker crossed the Rappahannock, massing 40,000 troops at Chancellorsville, Va., several miles west of Lee's stronghold, Fredericksburg. Gen. Lee dispatched 30,000 Confederate troops under Gen. Jackson to strike by a circuitous route at Burnside's right wing, under Gen. Howard. Lee was left with 18,000 troops under his own command. The diversion was successful, Howard's troops retreating in panic; Jackson, however, was mortally wounded by his own men. Next morning, May 3, Lee made a vigorous attack against the center and right of the Union line, under Generals Sickles and Slocum. Hooker became panic-stricken and failed to call 30,000 available reserves into action. The Union line gave way; but Lee was deterred from following up his advantage by news of the successes of Gen. Sedgwick, commanding the Union left. Lee was prepared to renew the battle on the 5th; but Hooker ordered a general retreat across the Rappahannock. Federal casualties were over 17,000; Confederate losses, about 12,500. Emboldened by this victory, Lee planned his later invasion of Pennsylvania.

**CHANCERY, MASTER IN.** Until the reign of Edward III a clerk connected with the Chancellor. Later, he still served the chancellor, acted as advisor, and was appointed to pass on certain specified subjects to be approved or not by the chancellor. In the U.S., masters in chancery are appointed to act as referees, and their findings are passed upon by the courts with which they are connected.

**CHANCRE**, a hard but usually painless sore, and is the first sign of syphilitic infection. The sore develops at the point of contact, usually about three weeks after exposure. It persists for weeks or months, with little tendency to heal. It is a dull red color, and the center usually becomes eroded and breaks down into an ulcer.

The chancre marks the point where the organism that causes syphilis has invaded the body through the surface. The secondary stage of syphilis follows the appearance of the chancre within three months. See also VENEREAL DISEASE.

**CHANDELIER**, a light fixture with branches, generally highly ornamental, which is suspended from the ceiling or roof. It was originally used for candles in churches and cathedrals; in the 8th century a chandelier holding nearly 1,400 candles was presented to St. Peter's by Pope Hadrian. The frames were at first made of wood or iron, painted or gilded, and

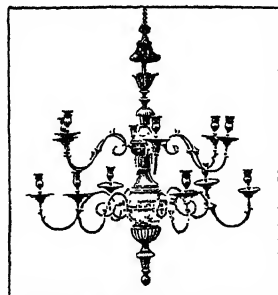
later of bronze, brass, silver, gold or ivory, ornamented with jewels or enamel. The designs and decorations of the branches followed the period art styles. The most brilliant chandeliers were those profusely hung with rock crystal, available from the 13th century, and later with glass prisms and globules. Interesting examples of modern indirect lighting may be seen in the chandeliers of the entrance halls of certain new office buildings.

**CHANDLER, JULIAN ALVIN CARROLL** (1872- ), American educator, was born at Guineys, Caroline Co., Va., Oct. 29, 1872. He graduated at William and Mary College, where he was instructor in history and English from 1891-92.

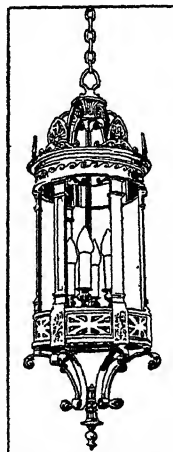
From 1900-04 he was professor of English at Richmond College, from 1907-09 edited the *Virginia Journal of Education*, and from 1909-19 was superintendent of Richmond schools. In 1919 Chandler became president of William and Mary College. His books include *Makers of Virginia History* and *Representation in Virginia*.

**CHANDLER, ZACHARIAH** (1813-79), American political leader and legislator, was born at Bedford, N.H., on Dec. 10, 1813. After receiving an elementary education, he moved in 1833 to Detroit, where he amassed a large fortune by trade and land speculation, and became a power in politics. In 1851 he was elected mayor of Detroit; the year following he was an unsuccessful Whig candidate for governor of Michigan. He helped to organize the Republican party in 1854, and became a member of its national committee two years later. For 18 years after 1857 he was a member of the United States Senate, and

through political manoeuvres, often unscrupulous, controlled the Republican machine in Michigan. In the Senate he was one of the leaders of the anti-slavery movement, standing adamant against compromise with the South. From 1861 to 1875 Chandler was chairman of the important Committee on Commerce, which controlled appropriations for public improvements. During the Civil War period he served on the Joint Committee on the Conduct of the War. He was violently opposed to Gen. McClellan, whom he attacked in a vitriolic speech in the Senate in 1862. When the war ended he supported the Congressional reconstruction measures, although he felt they were not sufficiently severe. He became Secre-



COURTESY M. M. OF ART  
ENGLISH CHANDELIER, ADAM  
STYLE (1750-1775)



COURTESY SECHRIST MFG.  
CO.

MODERN BRONZE  
CHANDELIER,  
ELECTRICALLY IL-  
LUMINATED

tary of the Interior under Grant in 1875, and in 1879 was again elected to the Senate, but died on Nov. 1 of that year at Chicago.

**CHANG HSUEH-LIANG** (1898- ), Chinese military and political leader, born in Fengtien province. As the eldest son of the Manchurian commander, Chang Tso-lin, he early came into prominence in Manchurian political and military affairs, being in active command of Manchurian troops in several campaigns into China proper. Following the death of his father in 1928, he became head of the Manchurian administration, and at the end of the year brought Manchuria under the nominal control of the Nanking Government. The movement of his troops into China proper in 1930 was the decisive factor in ending the anti-Nanking revolt of that year, and he was appointed to take charge of the administration in North China as well as Manchuria under the Nanking Government. One of the principal demands of the Japanese during their occupation of Manchuria in 1931 was that Chang should be permanently deprived of authority in that area. This demand grew out of the fact that he had been active in the promotion of Chinese railway building and industrial development, which came directly into competition with Japanese activities.

**CHANG KIA-NGAU** (1888- ), Chinese banker, was born in Kiangsu province, and is a graduate of Keio University, Tokyo. In 1912 he served as secretary of the Chinese Senate, and soon after became associated with the semi-governmental Bank of China. Since 1917 he had been vice-governor and active executive head of the Bank of China. He played a large part in the development of the National Bankers Association and the Shanghai Bankers Association, and to-day is one of the two or three best known and most influential bankers of China.

**CHANGSHA**, capital of the Yangtze province of Hunan, China. Changsha was opened to foreign trade by the Treaty of 1903 with Japan. Since then it has developed as an important distributing and collecting center for imports and exports in Hunan Province. The railway southward from Hankow which eventually will connect with Canton, passes through Changsha. From very early times Changsha has been the center of political and military disturbances, having been the capital of small kingdoms which declared the independence of the Chinese emperor, and in more recent years having been the center of radical and communistic agitation in central China. A medical school, Yale-in-China, is located at Changsha. Pop. 1929, approximately 585,000.

**CHANG TSO-LIN** (1873-1928), Chinese military leader, was born in the Manchurian province of Fengtien (now Liaoning), of peasant stock. During the Russo-Japanese War, 1904-5, he and his band of irregular soldiers cooperated with the Japanese. Subsequently he put his troops under the authority of the Manchurian Viceroy, and secured quick promotion in the army. At the time of the Republican agitation, 1911-12, he sided with the Republicans, and

in 1913 was made military governor of his native province. He rose rapidly to complete control of Manchuria, and, beginning in 1920, made several attempts to secure control in Peking, some of which were temporarily successful. In 1926 he succeeded in establishing his authority there, and over a large part of north China. In July, 1927, he declared himself Dictator of China, setting aside the remnants of the Republican form of government. A year later he was driven from Peking by the Nationalist forces. He was killed in an explosion which wrecked his train just before he reached Mukden on June 8, 1928.

**CHANNEL**, generally the deepest part of a river bed, through which the largest quantity of water flows, and the best navigable portion of the stream. With reference to a port, the channel is either the deepest, or that course in the approach of the harbor which is most easily navigated. It often has to be dredged continually in order to prevent it from being silted, by sand washed ashore or by mud brought down by the river, or from being clogged up by growing waterplants, as is the case with the upper Nile and the lower Mississippi. The upper reaches of the Nile, known as the "Sudd," had to be dynamited over long stretches before the river was opened to navigation.

**CHANNEL ISLANDS**, a group of islands in the English Channel, off the west coast of France. They belong to Great Britain, and consist of JERSEY, GUERNSEY, ALDERNEY and Sark, with some dependent islets. They lie between 48° 50' and 49° 45' N. lat., and 1° 50' and 2° 45' W. long. They are chiefly composed of gneiss which originally yielded a soil of no great natural fertility, but now is maintained at the highest degree of productiveness by lavish use of fertilizers and by diligent cultivation. The government is in the hands of bodies called the "States," some members of which are named by the Crown, while others are chosen by the people, and others sit *ex officio*. The islands form the only remains of the Norman provinces once subject to England. Area 75 sq. mi.; pop., 1931, 93,061.

**CHANNING, EDWARD** (1856-1931), American historian, was born in Dorchester, Mass., June 15, 1856. He graduated at Harvard where he became instructor in history in 1883, professor of history in 1897, and McLean professor of ancient and modern history in 1913. He was one of the founders of the American Historical Association, of which he was president in 1920. Channing's major work was his *History of the United States*, which was planned to comprise eight volumes. At the time of his death, however, only the sixth volume had been completed, carrying the story up to 1865. For this volume he was awarded the Pulitzer Prize for the best American history of 1925. As stated in the preface of his work, Channing aimed to treat the growth of the American nation as "one continuous development from the political, military, institutional, industrial and social points of view." Although somewhat lacking in unity, it displays a scholarly objectivity, a wide range of

sources, and illuminating discussions of problems which happened to interest the author. Other works include: *The Jeffersonian System*, 1801-11 (American Nation ser.); and *Guide to the Study of American History* (with Prof. A. B. Hart and F. J. Turner). Channing died at Cambridge, Mass., Jan. 7, 1931.

**CHANNING, WILLIAM ELLERY** (1780-1842), American preacher, was born at Newport, R.I., Apr. 7, 1780. He graduated from Harvard in 1798, and in 1802 was appointed regent of that college. The following year he became pastor of the Federal Street Church of Boston, where he preached for the remainder of his life. Despite his spirit of amity, Channing's liberal views made him the leader of the controversy which resulted in 1825 in the organization of the American Unitarian Association. He also organized the Massachusetts Peace Society. On the pedestal of Channing's statue in the Boston Public Garden is the inscription "He breathed into theology a humane spirit." His preaching was eloquent, his nature lofty. His writings include critical comment on famous men, and *Remarks on American Literature*. Channing was elected to the Hall of Fame in 1900. He died at Bennington, Vt., Oct. 2, 1842.

**CHANT**, a form of ecclesiastical music, in which prose passages are recited, generally in seven-measure phrases. The recitation, as one of the Psalms for example, is sung in monotone, but is relieved by conventional developments in the dominant melodic pattern. The chant is most common in the Anglican Church, in which the usual seven-measure phrase is divided into a three-measure and a four-measure passage, each traditionally preceded by one or more measures of recitation. After this point the chant assumes its distinctive rhythmical cadence. The conventional chant is written for four voices. In the Gregorian Chant, as distinguished from the Anglican, the opening passages are called an intonation; this is followed by two recitations separated by a mediation, which leads to the characteristic cadence. The Gregorian Chant is always sung in unison.

**CHANTERELLE** (*Cantharellus cibarius*), one of the choicest of the edible mushrooms, long prized for its agreeable nutty flavor. It grows in great abundance in woods and open places in many parts of Europe, where it has been a favorite in fine cookery since Roman times, and is found widely also in the United States and Canada. The plant, which grows from 2 to 4 in. high, is recognized by its rich chrome yellow color. The short rather thick stem, dilating upward into deeply decurrent, forked gills, terminates in a firm, fleshy cap, with a somewhat irregular wavy margin. Upon slicing, the compact, yellowish flesh emits a fragrant, fruity odor. See also MUSHROOMS; MOREL; PUFFBALL; TRUFFLE.

**CHANT ROYAL**, a verse form invented by the medieval French poets, probably in the 13th century, consisting of five stanzas of 11 lines each and an envoi of eight lines, each of the six parts ending with a like refrain. It was best suited to solemn religious subjects or to those of heroic exploits. In Old French,

the finest *chants royaux* are by CLÉMENT MAROT. The form was first used in English by EDMUND GOSSE in his *Praise of Dionysius*, 1877.

**CHANTRY**, a little chapel or an altar in a cathedral, where priests pray and celebrate masses for the repose of the souls of the donors.

**CHANUKAH**, Jewish festival. See MACCABEES, FEAST OF.

**CHANUTE**, a city in southeastern Kansas, in Neosho Co., situated near the Neosho River, 140 mi. southwest of Kansas City. Two railroads, bus lines and an airport serve the city. Chanute lies in the mid-continental oil and gas fields of the United States. Grain and fruit are the agricultural products of the region. The city has flour mills, oil refineries and machine shops. In 1929 the manufactures were valued approximately at \$1,000,000; the retail trade amounted to \$6,380,984. Chanute, founded in 1870, is the consolidation of four towns, New Chicago, Tioga, Chicago Junction and Alliance. It was incorporated as a city in 1872. Pop. 1920, 10,286; 1930, 10,277.

**CHAPALA, LAKE**, the largest lake in Mexico, situated at 20° N. lat. on the boundary between the states of Michoacan and Jalisco. From east to west it is 90 mi. long and its width is 30 mi. The depth is uneven. At its eastern extremity it receives the Lerma River which issues from its northern bank under the name Rio Grande de Santiago. Lake Chapala's location is picturesque, being high in the Sierra Madre Mountains at 5,159 ft. above sea level where the climate is perpetually that of Indian summer. Numerous islands dot its surface and tropical woods, including mango and palm trees, grow close to the water's edge. On its shores is the Mexican Riviera.

Chapala is the Mecca of the southern flight of legions of song birds and wild fowl, including geese from Canada, cranes, blue herons and the American egret. Its name is an Indian word used to describe the soft lap of the waves against the shore.

**CHAPARRAL**, a dense growth of low, thorny, hard-leaved shrubs and stunted trees that often completely covers large areas in warm arid regions. In southern California chaparral is the characteristic vegetation of dry mountain slopes at 1,000 to 4,000 ft. altitude. Ecologically chaparral is a dwarfed forest formation developed by the alternation of short, cool, wet winters with long, hot, rainless summers. According to W. L. Jepson the California chaparral shows also the effect of fire-ravage extending through a period of many thousands of years. Of the 100 or more species found in the California chaparral belt some of the most common and widespread are scrub live oak, manzanita, buckbrush or California lilac (*Ceanothus* sp.), buckthorn, chamise, sumach and sage. Although beekeepers reap rich harvests from the honey plants that grow profusely in the chaparral, its most important role is that of water conservation, especially on water sheds. The dense interlacing growth, both of branches and roots, prevents a quick run-off in the rainy season and retards evaporation during the hot period. Vegetation resembling



chaparral occurs along the coasts of Mediterranean Europe and Asia, South Africa, Chile and southern Australia.

A. B. J.

**CHAPARRAL COCK**, a name sometimes given to the road runner, a large, swift-footed species of ground cuckoo common in the chaparral districts of the southwestern United States and northern Mexico. See ROAD RUNNER.

**CHAPARRAL PEA** (*Pickeringia montana*), a stiff, spiny, evergreen shrub of the pea family characteristic of the chaparral belt at 2,000 ft. to 5,000 ft. altitude in California mountains. It grows from 3 to 8 ft. high with rigid, interlacing branches bearing



FROM JEPSON MAN FL PLANTS CALIF., COPYRIGHT

CHAPARRAL PEA

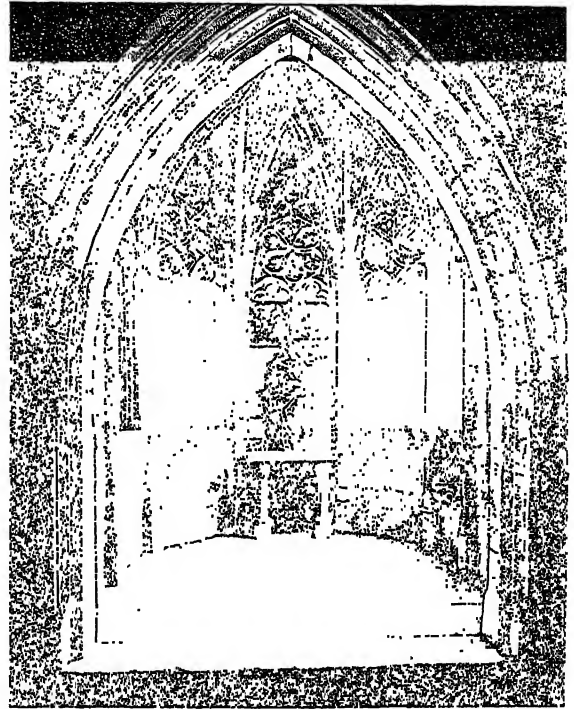
Single flower and flowering branchlet

numerous palmately divided leaves, rose-purple, pea-like flowers and small, many-seeded pods. On the roots are very large clusters of bacterial nodules.

**CHAP-BOOK**, a type of booklet or TRACT generally having 24 pages printed on the cheapest paper and sold to the common people for a penny. Chap-books in France, England and in America were hawked about by chapmen or *colporteurs*, and consisted of ALMANACS, farces, songs, ballads, accounts of ghosts and witches, theological tracts, interpretations of dreams, tales of coarse humor, and the like. They were the only printed form of popular literature until about the 19th century, and are now eagerly sought by bibliophiles as curiosities.

**CHAPEL** (late Latin *Capella*, from Latin *capa*, a cloak also covering the head, cap) originally a small ecclesiastical building to contain a relic; later, in contrast to the parish church, the term for any smaller church, either at a distance, as in cemeteries or in the country, or in private buildings, for the purpose of divine service. Such chapels were frequent in royal palaces and castles. Besides these separate chapels, there were those belonging to the church building, either at the side or beneath it. The latter sort are called crypts, which are often burial chapels of the founders of the church or rulers. They are usually under the choir, and have altars for services in memory of the dead resting there and of the saints to whom the crypts are dedicated. The ambulatory of Gothic churches is frequently surrounded by

chapels. In the late Gothic period, when the buttresses did not extend outwards, but were inside the church, chapels were automatically formed down the sides of the edifice. In the Renaissance and Baroque styles of architecture these side chapels were also greatly in vogue, each having a separate altar and dedicated to a special saint. The most famous of all



COURTESY DETROIT INSTITUTE OF ART

A FRENCH GOTHIC 15TH CENTURY CHAPEL  
From the Chateau of Lanoy, in Lorraine

is the Sistine Chapel in the Vatican at Rome. It is of importance in the history of art because of the frescoes by great artists and particularly the powerful works of Michelangelo—the ceiling painting of the creation and the fall of man.

**CHAPELAIN, JEAN** (1595-1674), French poet and critic, was born in Paris in 1595. At the invitation of Richelieu he organized the French Academy in 1635 and became one of the original members. The dictionary of the Academy was planned by Chapelain, who also influenced the Crown in the matter of distribution of honors and pensions to authors. It was with his epic poem, *La Pucille*, a work occupying 20 years and proclaimed at the time a triumph of human genius, that he won his fame. Only a short time afterward the sarcastic ridicule of his poem by Boileau sent him to oblivion. Chapelain died in Paris in 1674.

**CHAPEL HILL**, a town in Orange Co., northern North Carolina. It is situated 10 mi. southwest of Durham and is served by bus lines and the Southern Railroad. Chapel Hill is the seat of the UNIVERSITY OF NORTH CAROLINA, founded in 1789. Cotton and

tobacco are grown in the vicinity. The town is mostly residential and has the city manager form of government. Pop. 1920, 1,483; 1930, 2,699.

**CHAPLAIN.** The word is derived from the late Latin *capellanus*, the ecclesiastic entrusted with the cloak, or *capella*, of St. Martin, the most highly-prized relic of medieval France. In general, chaplains are clergymen, usually without the care of souls, charged with such functions as public prayer, the recitation of offices or the celebration of Mass. In the Roman Catholic Church beneficed chaplains are supported by funds left by the founder of the benefice. Chaplains are appointed to conduct religious services in convents, hospitals and other institutions. Kings and noblemen may maintain chaplains for their private chapels; the term is applied also to clergymen of various religious bodies who are attached to the army and navy.

**CHAPLIN, CHARLES SPENCER** (1889- ), American actor, was born at London, Apr. 16, 1889. His mother, of Irish and Spanish extraction, sang under the stage name of Lily Harley, but after the death of her husband she collapsed physically, and Charles and his brother Sydney had to support themselves. Charles made his first stage appearance in his mother's arms at three. At seven, in *Rags to Riches*, he did a clog-dance. He toured as a clog-dancer in vaudeville with *Eight Lancashire Lads*, and in a juvenile act impersonated Albert Chevalier in *My Old Dutch*. His first real successes were as Sammy the Newsboy in *Jim, or the Romance of Cocaine* and as Billy in the *Sherlock Holmes* of William Gillette, in London. He toured with Fred Karno's *A Night in an English Music Hall*. In 1913 Chaplin left Karno's *Night at the Club* company, playing then at Kansas City, Mo., to join the cast of *Tillie's Punctured Romance* under production by the Keystone company at Hollywood. Chaplin did not at first seem suited to the "slap-stick" of early film comedies, but later Mack Sennett gave Chaplin, in *A Film Johnny*, an opportunity to create the familiar figure which is that actor's satire on human vanity. Chaplin's pictures, which have been exhibited in nearly every country, include *The Kid*, *Shoulder Arms*, *The Gold Rush*, *The Circus* and, in 1931, *City Lights*, which made part use of sound effects. In 1931 Chaplin visited England again, was received by Prime Minister Ramsay MacDonald, and toured Europe, meeting Aristide Briand and other notables.

**CHAPMAN, ALVIN WENTWORTH** (1809-1899), American surgeon and botanist, was born at Southampton, Mass., Sept. 28, 1809. He was graduated from Amherst in 1830 and in 1833 became principal of the academy at Washington, Fla. While here he began his study of medicine, which he later practiced at Quincy and Marianna, and finally at Apalachicola, Fla. He is sometimes known as the Asa Gray of the South. One of his early specimens, sent to Gray and Torrey, was called *Chapmania*, 1838, in his honor. The first edition of his *Flora of the Southern States* appeared in 1860. He spent his

last years at work on a third edition of this great work. He died at Apalachicola, Apr. 6, 1899.

**CHAPMAN, FRANK MECHLER** (1864- ), American naturalist. In 1887, he became assistant curator of the American Museum of Natural History, New York. His writings, largely in the field of ornithology, include *A Handbook of Birds of Eastern North America* (1895), *Bird Studies with a Camera* (1900), *The Economic Value of Birds* (1903), *The Warblers of North America* (1907), *Camps and Cruises of an Ornithologist* (1908), *My Tropical Air-castle* (1929), and numerous contributions to magazines. In 1917-18, Chapman was director of the bureau of publications of the American Red Cross. He received the first Elliot medal of the National Academy of Sciences, and has been president of the Linnaean Society and of the Burroughs Memorial Association. In 1913, Brown University gave him the Sc.D. degree. Chapman has organized habitat bird groups and given many lectures for the Museum of Natural History. He was born in Englewood, N.J., June 12, 1864.

**CHAPMAN, GEORGE** (1559-1634), English poet and dramatist, was born near Hitchin, England, in 1559. He was known as a poet and dramatist in 1596, and his *Hero and Leander* appeared in 1598. For his part in the drama *Eastward Ho!* he was imprisoned by James I; later he found a friend in Robert Carr, Earl of Somerset, and to him Chapman dedicated his chief work, the translation of HOMER. Although most of his plays lack action, they contain good verse and fine thought. *Bussy d'Ambois*, and *Caesar and Pompey*, are among his best known serious dramas, and among his comedies are *All Fools*, and *The Gentlemen Usher*. Chapman died in London, May 12, 1634. See also ENGLISH LITERATURE.

**BIBLIOGRAPHY.**—*Works of George Chapman*, ed. by R. H. Shepherd, 1874-75; *The Plays of George Chapman*, ed. by W. L. Phelps, 1904.

**CHAPPING**, a condition of the skin characterized by excessive dryness and roughness chiefly of the exposed parts. It occurs in colder climates and during the winter months. A skin that has been overexposed to sunlight, ultra-violet light, or X-rays, is likely to present the more extreme grades of chapping. Probably the too free use of water and too alkaline soaps are a factor, as well as the dryness of the atmosphere. The natural tendency for the skin, as one grows older, is to become drier, due to the shrinking of the sebaceous glands and a consequent diminution in the natural lubrication of the skin. The only unpleasant consequence of chapping is fissuring—particularly of the hands and the lips. Occasionally it is accompanied by itching.

To overcome the tendency to chapping, it is advisable to avoid exposure to cold and wind, to use only the blandest superfatted soaps, and to keep the skin well lubricated with various oils, fats or creams. Preparations containing tragacanth, glycerine, olive oil or sweet almond oil are commonly employed. A number of the almond pastes on the market are useful.

Bran, starch, or oatmeal may be added to the water to soften the skin. See HAND LOTIONS. E. P. Z.

**CHAPULTEPEC, BATTLE OF**, Sept. 12-13, 1847, the last serious engagement of the MEXICAN WAR. Gen. Scott on the 12th opened a heavy bombardment upon the fortress of Chapultepec, three miles southwest of Mexico City. Under cover of the bombardment, on the following day, Pillow and Quitman assaulted the works successfully, and the Mexican troops fled panic-stricken down the precipices of Chapultepec to the city. The Americans had 863 killed and wounded, out of 7,500 troops engaged; the Mexican casualties numbered 4,000 out of a force of 25,000.

**CHARACTER, PSYCHOLOGY OF.** Character refers to the composite of an individual's traits and their fusion. It is a product of the reactions to experience in the sense that we inherit our temperaments and develop our characters. Those with similar temperaments may develop very different characters. The word carries other meanings. A person is said to have a strong, marked character, or a weak, flabby nondescript one. The word retains the moral implication of desirable and undesirable qualities; a miser and a philanthropist are or have very different characters. These uses, however justifiable, should not interfere with the modern and neutral sense which makes character the integration of acquired traits as shaped predominantly by the composite of experience, training and goals, always upon an original temperamental basis.

Historically the dramatic interest dominates. Theophrastus (370-288 B.C.) described characters, such as the miser, the flatterer, the bully, the pompous, the bore or the fool. This served as a model for later generations, notably the delineations of John Earle in 1628. The drama, no less than biography, has provided character studies from that day to this. Character reading is an equally ancient expression of an interest in determining human traits. It extends from PHYSIOGNOMY, ancient and modern, to PHRENOLOGY, and to all manner of reading mental traits in bodily signs. It harks back to the strange notions of ASTROLOGY, that reads fate and traits in the stars. In such systems temperament is equally and confusedly considered. This interest produced the antecedents of the shades of character and temperament.

**Modern Trends in Character Study.** The modern study of character is founded upon the knowledge of the relations between bodily and mental traits as an expression of nervous organization, and upon knowledge of the growth processes in the development of the individual. It may be said equally to arise from the data of behaviorism, and the differentiations of original and acquired nature.

There have been several attempts at a psychology of character, appreciative of its importance and the modern mode of approach. That of Bacon's is notable. He distinguished between traits inherent and traits external, deplored the purely literary treatment of the subject, and advocated a practical application

of the study of character to the affairs of life. Much later John Stuart Mill proposed a science of ethology, or study of character, to be pursued by carefully controlled conversations. So many and so various are the attempted solutions and approaches to this problem that Dr. A. A. Roback has compiled an extensive account of their scope in *Psychology of Character*, 1927.

Despite the rich fund of data bearing upon the subject, it cannot be said that there is any generally recognized body of findings which constitutes an accredited psychology of character. The contributions consist of a series of approaches attempting to determine what are the predominant characteristics in which men differ and which shape their integration. There appears clearly the relative emphasis upon temperamental factors, and upon the social environmental ones as they converge upon the personality. Since, however, no one lives and achieves upon a temperamental basis alone, since indeed what a man is must so largely be inferred from what he does, it is inevitable that the actual issues of observation should take the form of the data of character study.

An analogy from the affective life may be helpful. Its fundamentals are the instinctive urges and the emotional sets closely related to them; yet the actual level upon which we live emotionally is the sentimental one, in which our emotional responses have been shaped by reflection, experience and social heritage. They remain modified urges and emotions, but operate as principles, opinions and devotions. Similarly, in fact as another aspect of the same process, we live as characters rather than as temperaments. The effective life is that of character. Consider any comprehensive list of character traits: optimistic, magnanimous, conservative, liberal, radical, artistic, patriotic, practical, idealistic, literal, hard, soft, tolerant, narrow minded, eccentric, fanatic, and it becomes evident that the behavior in which men express their personalities is at the character level. Temperamental trends have been molded in complicated ways into character traits, one playing upon another in rivalry and interaction.

The concept of character converges upon the summation of the psychic endowment and upon that as an active going concern. Character is the total personality in action, yet focused upon the molding forces of the total setting in which every life is lived. But action proceeds upon motives. Hence one's character reflects one's motivations. It is the system of desires that directs in actions, which is the expression of an integrated self. For the reactions that go into the making of character are not passive yielding to circumstances, but an active consistent selection, in part temperamentally based, among the many patterns of behavior, sentiments, ideals, influences, competitive environments to which more or less one is exposed. Character waits upon opportunity and upon all outer circumstance, including freedom of expression, stimulation and encouragement or repression and discouragement. While thus conditioned, it proceeds equally

from within; how far puppets of circumstance, and how far masters of fate, is the decisive issue.

Simplify the environment, make it uniform and coercive, and the variability of character is reduced, though the temperamental variability supplied by nature continues to be effective. Because of the complicated play of urges and endowments, character issues from the training and direction of traits. (*See CHILD AND YOUTH, GUIDANCE OF.*) Training arises because native trends come in conflict with social pressures and the ideals of their desirable expression. Character comes to express the individual response to social pressures.

**Emphasis on Training.** A behaviorist view of the forces that determine personality emphasizes the training factor, one aspect of which is called conditioning; extreme behaviorism stakes all, character and career alike, on guidance. Without assenting to that position the comprehensive force of training in all behavior must be recognized and nowhere more so than in the psychology of character. It appears conspicuously in the acquired similarities of men, notably in national characteristics. For the very attempt to formulate the character of Americans, English, French, or Germans, is a recognition of complex environmental forces of which national character consists. The professional and the commercial occupations contribute to the stamp of personal character, which none the less remains individual. Ascetics and stern disciplinarians have a formative character trait in common; libertines and easy livers have another. Doctor, lawyer, merchant, beggarman, thief, are not merely careers but composite tendencies which belong in the character group. What appears on the surface of personality are character traits. The underlying uniformities of human nature give way to the universal varieties. In further illustration, consider the distinctive traits of men and women. Fundamentally, these are set by nature. But what expressions in the formed characters of men and women these shall take varies widely with the molding forces of the cultures under which men and women live. There arise ideals of manly and womanly traits; and within these influences the character traits of women develop as variously among themselves as those of men, with both subject to common conditions. Furthermore, the individual's character changes through the periods of its growth. Moral and social training direct these changes toward standards that benefit human living. Biography deals with character; literature finds its hearth and home in the same domain that engages the studies of the psychologist. It is these bearings that will maintain an interest in the psychology of character and character traits.

**Dual or Multiple Personalities.** The development of personality is further illustrated in unusual cases of dual or multiple personality, which are the result of conflicting trends that fail to bring about a unitary adjustment. While the mechanisms of these are obscure and are associated with hysterical trends, they suggest the types of conflict that take place in

normal personalities. In this sense we all harbor several selves, a public self and a private self, a professional self, a social self, and may have conflicting systems of urges that are frustrated in their expression. Personality thus comes to be the organization of the dominant interests and strivings that determine the actual course of behavior. Ordinarily personalities are more or less stable by reason of such dominance. When any one set of these drives attains an exclusive hold, there may result a psychopathic personality or tendency in that direction; such are the eccentrics, fanatics, ascetics, recluses, even the constitutional vagrants and certain orders of criminal offenders.

The psychopathology of personality must likewise be considered. With changes in the structure or nutrition of the brain, with subtle disturbances alike functional and in the emotional life, the personality alters. Mental disorder reveals the complication of the components of a normal personality. The changes of age may be similarly described. They all come under the formula of prepotent systems of urges, interests and social influences. Many of them may be as appropriately designated alterations of character. They are likewise illustrated by such phenomena as conversion. Biographers in analysing the personalities of their subjects describe periods of such changes in dominant activities, in changes of fortune or career.

The Freudian view of personality emphasizes stages of growth largely in terms of the sexual nature. It makes much of the fixation of the dominant affects, especially in relation to the parent. Abnormal personalities represent the continuance of such attachments beyond their proper period or a regression back to infantile forms of expression. The family romance, of which the Oedipus complex is the nucleus, becomes the main plot of the drama of personality. There is no adequate basis for this view; it is suggested by psychoanalytic findings.

In brief, for various reasons it is important for psychology to recognize a division of its study which focuses upon traits of character and their fusion, despite the fact that the more inclusive term for this branch of psychological study has come to be recognized as *PERSONALITY*. There is the primary reason that the actual working level in which we meet the traits of personality is that in which these traits have been worked upon by environmental circumstances. Character, without constant reference to the personality of which it is an expression, would be a misleading concept. Consequently the combination of the terms character and temperament has long been established, particularly in the French usage, to make clear that a dual reference is everywhere pertinent. J. J.

*See J. Jastrow, Character and Temperament, 1916.*

**CHARADE**, a riddle game, first played in France, or Italy, during the 18th century, in which the meaning of a word of two or more syllables is guessed by explaining each syllable as a separate word. Charades are written in either prose, or verse; but the favorite way to play the game is for one or more persons to

act out each syllable, preferably in costume, and then give an impression of the whole. The following is a simple charade in verse:

In my first I love to ride,  
With my second by my side;  
On my whole we walk and roam,  
Every day within our home.

The word is carpet.

**CHARCOAL.** See CARBON; CARBON, ACTIVATED; also WOOD DISTILLATION.

**CHARCOAL DRAWING**, a comparatively modern technique. Street-boys and dawdling servants in old Rome marked with charcoal on walls and doors. The artists of the Renaissance used charcoal in sketching rough drafts of their cartoons, but in general it was not a distinguished medium. The rise of charcoal drawing began in the art-schools of the 18th and 19th centuries, chiefly in France. *Fusain* (charcoal) is a small tree the twigs of which when reduced to charcoal are capable of sensitive markings. It is a medium by no means easy to master. The paper generally used is slightly ribbed. A charcoal-drawing when finished is as perishable as pastel and requires to be "fixed," a process that consists of spraying it with gum-arabic dissolved in alcohol.

**CHARCOT, JEAN MARTIN** (1825-1893), French physician, was born in Paris, Nov. 29, 1825. He studied and took his medical degree in Paris in 1853. In 1862 he became associated with the great hospital for mental diseases known as the Salpêtrière and created the greatest neurologic clinic of modern times. He studied deviations in human physiology and anatomy, and left memorable descriptions of many diseases. He studied hysteria, investigated and practiced hypnotism, eventually regarding it as a measure of doubtful value. He is recognized as one of the greatest investigators of nervous diseases in the history of medicine. He died Aug. 16, 1893.

**CHARD** (*Beta vulgaris* var. *Cicla*), called also Swiss chard, a variety of the beet much prized as a vegetable in Europe though of limited use in the United States. It differs from the common beet in having larger, pulpy, thickened leaves and small woody roots. The very thick white leafstalks and midrib are cooked like spinach as a potherb. The blanched inner leaf stalks of the CARDOON are also known as chard.

**CHARING CROSS**, in London, England, a busy open space between the west end of the Strand and Trafalgar Square. It was named after the village of Charing or Chering, which once stood on the spot, and the stone "Eleanor cross" erected there by Edward I in 1291; the original cross was removed in 1647, and a copy erected in Charing Cross Station courtyard in 1865. On the southwest side of Charing Cross is the Admiralty Arch, by Sir Aston Webb, and in the center is Hubert Le Sueur's statue of Charles I.

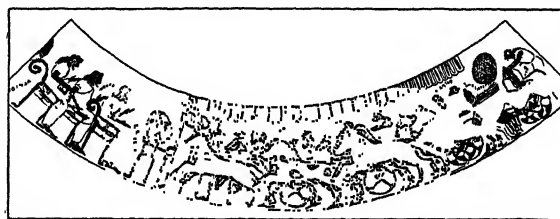
**CHARIOT RACING**, the most popular sport of the circuses of the late Roman and Byzantine empires.

The chariots were heavy, two-wheeled, single-poled vehicles, drawn by four horses abreast, and the usual race was run for seven circuits of the circus. Four chariots were usually entered in each race, each representing one of the four associations of charioteers. The



ASSYRIAN CHARIOT (A RELIEF IN THE BRITISH MUSEUM)

sport was to the highest degree professional, was supported by government subsidy, and probably ranked even above the arena shows in the taste of the city crowds. Juvenal lists free circuses with free bread as the only two things for which the Roman people lived.

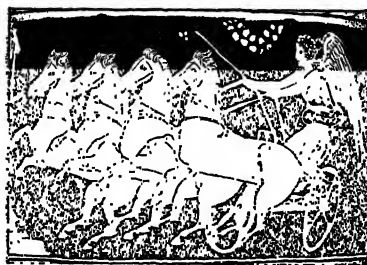


COURTESY M. M. OF ART

#### FINISH OF A CHARIOT RACE

With the judges seated nearby, the chariots pass the goal at full speed. Segment of a Greek krater in the Altes Museum, Berlin

In fact most of the citizens were violent partisans of one or the other of the charioteers' associations and bet heavily upon a favorite group or driver. At Constantinople there were only two parties; but their animosity was all the more bitter and often resulted in disorder.



COURTESY M. M. OF ART

#### NIKÉ DRIVING A QUADRIGA

From a red-figured Greek krater, 5th-6th century B.C.

In the Nika, sedition against Justinian contributed to the outbreak of actual revolution. Many of the emperors were opposed to the morbid, vicarious excitement which the races furnished the populace, but never felt strong enough to interfere effectively.

**CHARITABLE TRUSTS**, trusts created for public or private benefits. Hospitals, libraries, and homes for the old or infirm are examples of public Charity Trusts. These trusts, being for the general good of mankind, are not so limited as private ones. For



instance, they can endure forever, whereas a private trust is limited by law to a certain term of years. Private charitable trusts must be very clear not only as to purpose, but as to the particular beneficiary, and all limitations of law must be strictly observed. While encouraging charitable trusts, the law does not ignore private rights, especially in regard to WILLS, some states permitting not more than a third of an estate to be willed to charity to the loss of dependents.

**CHARITIES** or **GRACES**, in Greek mythology, the three goddesses of grace and beauty, called in Latin *Gratiae*. They were daughters of JUPITER. Their names were Aglaia or Brilliance, EUPHROSYNE or Mirth, and Thalia or Luxury. The goddesses attended APHRODITE, and were associated with the MUSES as patrons of art and poetry, presiding especially over festivals and exhibitions of physical grace. Their shrine was at Orchomenus in Boeotia, where their festival was called the *Charitesia*. The Charities are pictured as three beautiful nude maidens.

**CHARITON**, a city in southern Iowa, the county seat of Lucas Co., situated 50 mi. southeast of Des Moines. Bus lines and two railroads afford transportation. The region is fine farm land, growing grain and hay. There are coal fields near by. The city's chief manufacture is brooms. Chariton was settled about 1850. Pop. 1920, 5,175; 1930, 5,365.

**CHARITY**, as understood by the Hebrews and the early Christians, the donation of sums to the poor, an act held by both religions as incumbent upon persons of comfortable means. Coincident with the growth of the Christian Church in the Middle Ages the practice of almsgiving grew from an individual transaction between rich man and beggar to an extensive system of practical charity, chiefly directed by the monks, abbots and other officers of the Roman faith. Inevitably the system was abused, but nevertheless the Church was for centuries the most efficacious agent in the field of immediate charity, and the tradition was strong that the poor man must not return empty-handed from the monastery. In modern history the English Poor Relief Act of 1662 may be said to mark the first recognition by a state of its philanthropic duty, and under this measure landholders were taxed to support workhouses and homes for the aged. Mismanagement of these sums for charitable work by the regional directors disclosed that English poor-relief required a central administration, which was created in 1853 by the Charitable Trust Act, providing a board of charity commissioners who were empowered to expend state and private contributions on medical and other relief. But the growing industrialization of urban centers revealed the weaknesses of a system, also prevailing on the Continent and in the United States, that permitted a large play of ill-considered individual charity. The Charity Organization Society, established in England in 1869 and in the United States in 1877, opposed individual charity and proposed to administer relief on the basis of scientific surveys. In the United States the funds for relief expended by the Charity Organi-

zation Society are supplied in many cities from a community chest, built up by citizens' contributions.

**CHARLEMAGNE**. See CHARLES THE GREAT.

**CHARLEROI**, capital of a Belgian district in the Hennegan province, situated on the Sambre River. Owing to the rich deposits of coal in the vicinity, manufacturing is important, principal products being machines, glass and ironware. It is also a leading railroad center. Surrounding Charleroi are busy industrial districts forming the most densely populated district in Europe. Originally named Charnoi, founded and fortified by the Spaniards in 1666, Charleroi is one of the newest Belgian cities. It has an athenaeum, and an archeological and a mineralogical museum. Pop. 1930, 28,069.

**CHARLEROI**, a borough of southwestern Pennsylvania, in Washington Co., situated on the Monongahela River about 25 mi. southeast of Pittsburgh. The Pennsylvania railroad affords transportation. Charleroi manufactures plate glass and glass products, and has iron works. In 1929 the output of manufactures was \$5,298,235; the retail trade was \$7,561,810. Pop. 1920, 11,516; 1930, 11,260.

**CHARLES I** (1887-1922), Emperor of Austria and King of Hungary was born in Persenbeug, Lower Austria, Aug. 17, 1887. He was the son of Archduke Otto and Princess Maria Josepha of Saxony. He was married to the princess Zita of Bourbon-Parma Oct. 1911. As the heir of his grandfather, the Emperor Francis Joseph, he ascended the throne on Nov. 21, 1916, during the trying times of the World War. In Nov. 1918 he was forced to abdicate and went to Switzerland. He made several unsuccessful attempts to regain the throne and finally was forced to seek asylum in Portugal where he died Apr. 1, 1922.

**CHARLES V** (Charles I of Spain) (1500-58), German Emperor and Holy Roman Emperor, was born at Ghent in Flanders, Feb. 20, 1500. His father, Philip, Archduke of Austria, died in 1506 and his mother Joanna, daughter of Ferdinand and Isabella of Spain, became insane immediately thereafter. Charles therefore became heir to the vast possessions of his grandfathers Maximilian and Ferdinand. The death of Ferdinand in 1516 transferred the Spanish possessions to Charles and the death of Maximilian two years later left Charles the hereditary domains of the Hapsburgs. Although Pope Leo X strongly favored the candidacy of Francis I of France, Charles was elected German Emperor in 1519 and crowned in 1520. The problems that confronted Charles at the commencement of his reign were of a complicated nature. His vast dominions showed little trace of administrative unity. Independent governing bodies existed in Castile, Aragon, Naples, Sicily and Sardinia as well as in the separate states of the Hapsburg group. One of Charles's first steps accordingly was to lighten the administrative burden by transferring the government of the Hapsburg states to his younger brother Ferdinand, who by marriage established a claim to the kingdoms of Hungary and Bohemia. The growth of Protestantism in Germany and the

entanglements of foreign politics added to the problems facing Charles. The latter involved him in a series of wars with Francis I of France, while at the same time he was menaced by the advance of the Turks in the East and on the Mediterranean. Francis laid claim to Naples and Milan and it required eight years of practically continuous warfare before Charles made good his claims in Italy, and peace was signed at Cambrai in 1529. The Pope, too, had been hostile to Charles, but they came to terms and Charles received the imperial crown at the Pope's hand in 1530. Meanwhile the Turks under Suleiman the Magnificent had turned Hungary into a Turkish province and had even laid siege to Vienna in 1529. For fifteen years thereafter Charles and Ferdinand made repeated although futile attempts to dislodge Suleiman from his newly acquired provinces and finally in 1547 they were compelled to recognize the Turkish power even to the extent of paying an annual tribute to the Sultan who was then threatening the Hapsburg realms not only in Austria but even in Italy and Spain. Internally the imperial ambitions of Charles ran sharply counter to the possibilities of German nationalism and German unity. The rise of Lutheranism seemed to Charles to destroy the religious unity that should exist as he thought in the empire, and the German knights who would otherwise have supported Charles in his struggles with the princes and the burghers soon also turned against him after the emperor and the pope broke with Luther in 1520. The Knights' War of 1522 followed by the Peasants' Revolt in 1525 were illustrative of the disruptive influences and complex social antagonisms disintegrating the German realm. Lutheranism finally led to armed conflict. After initial success Charles found it impossible to crush the Lutheran princes. Weary and discouraged he left the task of negotiating peace (the Religious Peace of Augsburg, 1555) to his brother Ferdinand. The following year he abdicated, dividing his empire between his son Philip, who received the Spanish possessions (including the new overseas colonies and the Burgundian inheritance) and Ferdinand, who received the Hapsburg possessions in Germany. Charles died at Estremadura, Spain, Sept. 21, 1558.

**CHARLES**, name of seven Holy Roman emperors: Charles I, the Great, Charlemagne (724-814). Charles II, the Bald (823-877), by the treaty of Verdun 843, received west France as his share of his father's inheritance and in 875 the imperial crown. Charles III, the Fat (c. 832-888), son of Louis the German, united for a time East and West Francia and was crowned emperor at Rome in 881. His indolence and cowardly tolerance of invading enemies resulted in his deposition 887. Charles IV (1316-78), a Luxemburger, was elected German king in 1346 and became emperor in 1355. He was an intelligent scholar and diplomat who, despite continual difficulties in the empire as a whole, made Bohemia a powerful and prosperous country. He promulgated the Golden Bull, 1356, and founded the University

of Prague. Charles V (1500-58). Charles VI (1685-1740), son of Emperor Leopold I, proclaimed himself King of Spain in 1703, and was elected to the imperial throne in 1711. He established the Pragmatic Sanction in order to assure the inheritance of his possessions for his daughter, Maria Theresa. Charles VII, Charles Albert (1697-1745), son of Maximilian Emanuel of Bavaria, claimed the imperial crown after the death of Charles VI and was made emperor in 1742 at Frankfort. He carried on a disastrous war against Maria Theresa of Austria.

**CHARLES**, name of 10 rulers of France. Charles I, the Great, CHARLEMAGNE (742-814). Charles II, the Bald (823-877), son of Louis the Pious, crowned king 843, fought after his father's death with his half-brother, Emperor Lothaire, and brought about the TREATY OF VERDUN. Upon the death of his nephew, Louis II, he was crowned emperor, but died two years later. Neither Charles I nor Charles II can be called strictly kings of France. Charles III, falsely called "the Simple" (879-929), forced the usurper, Odo, to relinquish extensive lands and at the latter's death, became king of all France, but he could not withstand the Norman robbers and his unruly vassals, who imprisoned him. Charles IV, the Fair (1294-1328), ascended the throne in 1322. He supported his allies and relatives but was despotic and oppressive with his subjects. Charles V, the Wise (1337-1380), disliked war, but selected an able general who regained most of the English possessions in France. He encouraged commerce, arts and science. Charles VI (1368-1422), son of the preceding monarch, ascended the throne under the guardianship of his rapacious uncles, who oppressed the country. The king became insane and died soon after Henry V of England had married his daughter Katherine. Charles VII, the Victorious (1403-1461), was the sovereign crowned by Joan of Arc. Charles VIII (1470-1498), grandson of the preceding ruler, ascended the throne in 1483, acquired Brittany by marriage and conquered Naples as heir of the Anjous, but was later driven out by the Pope and an alliance of Italian states. Charles IX (1550-1574), son of Catherine de Medici who perpetrated the Massacre of St. Bartholomew. Charles X (1757-1836), only son of Louis XV and brother of Louis XVI and Louis XVIII, attempted to organize an invasion of France after the death of Louis XVI, but failed and thereafter lived in England. Under Louis XVIII he assumed a liberal attitude, but when in 1824 he succeeded his brother as king, he became reactionary and brought about the Revolution of 1830, which cost him his throne.

**CHARLES VII** (1403-61), the Victorious, King of France, was born in Paris Feb. 22, 1403. On the death of his father Charles VI in 1422 he found his succession seriously challenged by Henry VI of England. The English were finally driven from France by a series of campaigns following the relief of Orléans by Joan of Arc in 1429 and Charles was crowned at Rheims the same year. He died at Mehun-sur Yevre near Bourges, July 22, 1461.

**CHARLES IX** (1550-74), King of France from 1560-74, was born at Saint-Germain-en-Laye June 27, 1550. In 1560 he succeeded his brother Francis II. His mother, Catherine de' Medici, ruled for him as Charles was only ten years old. He was declared of age in 1563 though his mother still held the regency. His reign was characterized by intrigues and barbarities between Catholics and Protestants, both sides being encouraged and supported by Catherine de' Medici who influenced her son to consent to the Massacre of St. Bartholomew, Aug. 24, 1572. He died at the Chateau de Vincennes near Paris, May 30, 1574.

**CHARLES I** (1600-49), King of Great Britain and Ireland, was born at Dunfermline, Scotland, Nov. 19, 1600, second son of James I of England and Anne of Denmark. After the death in 1612 of his older brother, Prince Henry, Charles became heir to the throne. In his twenty-third year he went to Spain, accompanied by the Duke of Buckingham to pay court to the Infanta Marie, but negotiations for their marriage were not completed. James I died in 1625, and Charles came to the throne. His reign was unfortunate from the beginning, the first of a long series of disasters being the expedition against Spain in 1626. When Parliament refused his request for money, Charles resorted to raising funds by loans and other illegal means. Hostility toward him abated somewhat after the assassination in 1628 of Buckingham, his chief minister, but Parliament steadfastly refused to give the king funds for military projects on the continent. He angrily dismissed the House of Commons in 1629 and ruled for 11 years alone. The king's severe measures to raise money eventually led to civil rebellion. His treasury exhausted he summoned the Short Parliament in 1640, and attempted to force it to finance a punitive expedition against Presbyterian Scotland. Parliament refused and was dissolved. Charles raised funds for the unsuccessful invasion by other means. The Long Parliament was then convened. This body demanded an accounting from the king, who replied by entering the Commons with an armed force. Parliament in 1642 declared the country imperiled, and raised an army to combat the royal forces. Charles fled London, joined his troops at Edge Hill on Oct. 23, 1642, and won the opening battle in the civil war. The next year he was completely routed at Naseby. Imprisoned he escaped in 1647 to the Isle of Wight but was returned to England in 1648, tried as a national enemy, and beheaded at Whitehall, Jan. 30, 1649.

**CHARLES II** (1630-85), King of Great Britain and Ireland, was born at London, May 29, 1630, the son of Charles I. When his father was executed in 1649, Charles II was a refugee from the parliamentary forces at The Hague, but immediately assumed the royal title, and accepted an invitation from Scotland, being crowned on Jan. 1, 1651. Charles eluded Cromwell on his march north and invaded England with 10,000 men. In Sept. 1651 the parliamentary army surrounded the royalists at Worcester, and routed the invaders. With a price on his head, Charles fled to

Normandy, and spent the following eight years in exile. His fortune improved after Cromwell's death in 1658, when conditions in England led to a demand for restoration of the monarchy. Charles was crowned at Westminster Abbey on Apr. 23, 1661. Like his father, he demanded enormous funds of Parliament. In 1662 he married Catherine of Braganza. Pressed for money, Charles accepted subsidies from France by which he involved England in the successful war of 1672 against Holland. He dissolved Parliament in 1681, and ruled as absolute monarch until his death, at London, Feb. 6, 1685.

**CHARLES**, name of four kings of Spain: Charles I (1500-58), as German emperor he was Charles V. Charles II (1661-1700), an invalid and the last of the Spanish Habsburgs. Charles III (1716-88), king of the two Sicilies until he ascended the Spanish throne; was unfortunate in war, losing Florida for Spain. He was a superb administrator, building bridges, factories, roads, furthering agriculture and archaeology, and limiting the power of the Church. Charles IV (1748-1819), son of the former. He was involved in wars which destroyed Spain as a maritime power. Overthrown by his son, he renounced the throne under pressure from Napoleon.

**CHARLES IX** (1550-1611), King of Sweden and youngest son of King Gustavus Vasa was born in Sweden in 1550. On the death of his father in 1560, his brother John ruled Sweden until his death in 1592. The throne should then have naturally descended to John's eldest son Sigismund, then king of Poland and a Catholic. Since Sweden was predominantly Protestant the Riksdag deposed Sigismund and elected Charles as king in 1600. In the brief reign of 11 years Charles IX was involved in territorial and dynastic wars with Poland, Russia and Denmark. The king died in 1611 leaving the throne to his son Gustavus Adolphus.

**CHARLES X GUSTAVUS** (1622-60), King of Sweden, was born at Nyköping on Nov. 8, 1622. He was a cousin of Queen Christina and was betrothed to her. When Christina decided that she would never marry, she had Charles Gustavus chosen as her successor. When she abdicated in 1654, he became king. He found the country in a precarious state. The national debt was enormous and the revenues insufficient. The people were discontented because of the oppression of the nobility, whose powers had been greatly augmented during the reign of Christina and the regents who ruled during her minority. Charles Gustavus undertook to remedy these conditions by reappropriating some of the crown lands that had been ceded to the nobles, but he soon found himself involved in war. Since King John II Casimir of Poland laid claim to the throne of Sweden, Charles Gustavus invaded Poland and defeated the Poles near Warsaw in 1656. Not long afterwards King Frederick III of Denmark declared war against Sweden, hoping to win back some of the territory his country had lost in 1643. Charles Gustavus invaded Denmark in 1658, conquered Schleswig, Hol-

stein and Jutland, but failed in the attempt to take Copenhagen. In the ensuing peace, Denmark was forced to make important concessions. Charles Gustavus died at Gothenburg, Feb. 13, 1660.

**CHARLES XI** (1655-97), King of Sweden, son of Charles X of Sweden, was born in Stockholm, Nov. 24, 1655. He ascended the throne of Sweden at the age of four and for the succeeding two decades was surrounded by incompetent and inefficient advisors. His energetic nature asserted itself at the threat of a Danish invasion and he succeeded in defeating the army led by Christian V. of Denmark in the famous battle of Lund, 1677. He then turned his attention to the internal reconstruction of Sweden until his death, in Stockholm Apr. 5, 1697.

**CHARLES XII** (1682-1718), King of Sweden, was born at Stockholm on June 27, 1682, the son of Charles XI. He received careful education at the hands of the very best tutors and of Charles XI, who early introduced him to the details of royal administration. Accordingly, when Charles's father died in 1697, the *Riksdag*, fearing the power of the regents appointed by Charles XI, offered the crown to Charles, then 15 years old. He accepted the offer, and conspicuously declined to take the coronation oath.

At 17 years of age he was forced to lead the Swedes against the coalition of Denmark, Poland and Russia. Choosing to invade Denmark first, he soon landed there after a daring sea voyage, and wrung an advantageous peace from **FREDERICK IV.** Turning to Russia, he inflicted a crushing defeat on the tsar's forces at Narva, annihilating the Russian army. He set up a Swedish governor in the duchy of Courland. Not wishing to have his third enemy, Poland, at his back, Charles invaded Poland and occupied Warsaw in 1702. He won the battle of Klissow and took Cracow in one month. In the next year he won almost the whole of Poland, and in 1705 set up his candidate, Stanislas Leszczynski, as king.

Making amicable diplomatic settlements with England and the Holy Roman Emperor, Charles began the disastrous invasion of Russia. He won the battle of Holowczyn, his last victory. The Russians under Peter the Great began the masterly retreat toward Moscow which closely resembles that which led to Napoleon's destruction in 1812, and, when winter and shortage of provisions had taken their toll of Charles's army, Peter attacked and inflicted a terrible defeat on the Swedes and their allies, the Cossacks, at Pultowa.

From 1710-14 Charles remained in Turkey, where he fled after Pultowa, trying to stir up a war between the Porte and Russia. Unsuccessful in this attempt, he returned to Sweden in 1714, formed another army, and attacked Norway in 1717-18. During the latter year, while besieging Fredriksten, he was killed on Dec. 18.

**CHARLES XIV (JEAN BERNADOTTE)** (1763-1844), King of Sweden and Norway, and founder of the present-day Swedish reigning family, was born at Pau, France, on Jan. 26, 1763, the son of a French lawyer. At the age of 17 he entered the

French army, seeing action first in Corsica. In the next 30 years Bernadotte gained wide prestige as a soldier, and historians credit him with a leading rôle in many of Napoleon's victories. He was made a general in 1794 and later became one of Napoleon's ablest and most trusted marshals. In 1799 he was appointed minister of war and in 1805 marshal of France. In 1805 Bernadotte greatly antagonized Prussia by marching his troops through the neutral territory of Anspach to join Napoleon in the campaign against the Austrians. After the occupation of Vienna he rendered particularly brilliant service against the combined Austrians and Russians at the battle of Austerlitz, Dec. 2, 1805.

Having made peace with Napoleon early in 1810, Sweden joined the continental system, and Charles XIII chose Bernadotte as his successor, making him crown prince of Sweden. Because of disagreement with Napoleon over the conduct of the war and the emperor's foreign policy in general, Bernadotte left him and went over to the allies. Recognizing his ability, they entrusted him with the command of the "army of the north." In 1813 he took an active part, though at times none too energetic, in the campaign of the Elbe against his old master and fought with the allies in the battle of Leipzig, in which Napoleon's power was crushed. Upon the death of Charles XIII in 1818, he ascended the throne of Sweden as Charles XIV, and ruled till his death at Stockholm on Mar. 8, 1844.

**CHARLES XV** (1826-72), King of Sweden and Norway, eldest son of Oscar I, king of Sweden and Norway, was born in Sweden May 3, 1826. In 1859 after his father's death he became king. In 1863 he gave his consent to the reform of the Scandinavian constitution. Charles XV was one of the most popular of Scandinavian rulers. He died at Malmo in Sweden, Sept. 18, 1872.

**CHARLES, KARL ALEXANDER** (1712-80), Prince of Lorraine, was born at Luneville, Dec. 12, 1712. In 1740 he was made field marshal of the Austrian army and in 1744 became governor general of the Austrian Netherlands. He led the army against the Prussians in 1745, and again in 1757 until the defeat of Leuthen, Dec. 5, 1757. He retired to Brussels where he lived until his death, July 4, 1780.

**CHARLES CITY**, a city in northern Iowa, the county seat of Floyd Co., situated on Cedar River about 40 mi. northwest of Cedar Falls. Two railroads serve the city. It lies in a rich agricultural district. The chief manufactures are farming machines and other iron products, hosiery and office equipment. Pop. 1920, 7,350; 1930, 8,039.

**CHARLES EDWARD (STUART)** (1720-88), English prince known in history as the Young Pretender, was born at Rome, Dec. 31, 1720. His grandfather was King James II of England and his father was the exile James, the Old Pretender. After several unsuccessful attempts to enlist the assistance of the French in an effort to regain the throne of England for the Stuarts, Charles Edward entered Scotland in

1746 and placed himself at the head of an irregular army drawn from the Scottish clans. He was decisively defeated at the Battle of Culloden, Apr. 16, 1746. The Prince fled and escaped to France after great hardship. There he spent most of the remainder of his life in plotting and in drunken debauchery. He died at Rome, Jan. 30, 1788.

**CHARLES' LAW**, or Gay Lussac's Law, states that at constant pressure, the volume of a given mass of any gas increases by  $1/273$  of its volume at  $0^\circ \text{C}$ . for an increase of  $1^\circ \text{C}$ . in temperature. Provided the gas conforms to Boyle's Law, this may be stated also in terms of constant volume. At constant volume, the pressure of a given mass of any gas increases by  $1/273$  of its pressure at  $0^\circ \text{C}$ . for an increase of  $1^\circ \text{C}$ . in temperature.

These statements can also be given by the following equations, in which  $v_t$  and  $p_t$  are respectively the volume and pressure at  $t^\circ \text{C}$ .,  $v_0$  and  $p_0$  the volume and pressure at  $0^\circ \text{C}$ . and  $\beta_p$  and  $\beta_v$  the subscripts denoting the quantity which remains constant:

$$v_t = v_0(1 + \beta_p t)$$

$$p_t = p_0(1 + \beta_v t)$$

where  $\beta_p = \beta_v = 0.003663 = 1/273$ .

Careful experiments have shown that the values of  $\beta_p$  and  $\beta_v$  vary slightly from one gas to another and that for any one gas  $\beta_p$  is not exactly equal to  $\beta_v$ . But these differences are small compared to the wide differences that exist in the coefficients of expansion of the different solids and liquids. In other words, most gases differ only very slightly from the ideal gas for which  $\beta_p = \beta_v = 1/273$ .

By measuring temperatures on the ABSOLUTE TEMPERATURE SCALE, Charles' Law can be stated in much simpler and more convenient forms; viz., at constant pressure, the volume of a given mass of any gas is proportional to its absolute temperature; at constant volume, the pressure of a given mass of any gas is proportional to its absolute temperature. Boyle's Law and Charles' Law can be combined into the single equation, often called the *gas law equation*  $pv = mRT$ . In this equation,  $p$ ,  $v$ ,  $m$  and  $T$  are the pressure, volume, mass and absolute temperature, respectively, and  $R$  is the so-called *gas constant*.

W. W. S.

**CHARLES MARTEL** (c. 688-741), "the Hammer," was born about 688, the son of Pepin II. Although his mother, Plectrude, attempted to put him out of the way, he managed to gain sovereignty over all the petty kings of the Franks, and was ambitious to extend his rule further. In 719 he was the head of all the Franks. In 732 at the BATTLE OF TOURS or Poitiers, assisted by Eudo of Aquitaine, he turned back the threat of the Moors to sweep over western Europe. He defeated them again in 739, and drove them back to their haunts behind the Pyrenees. In 741 he split the Frankish realm between his sons, Carloman and Pepin, giving the former Austrasia, Alemannia, Thuringia and suzerainty over Bavaria, and the latter—the father of CHARLEMAGNE—Neustria, Burgundy and Provence. Charles died on Oct. 22,

741. In the legends and ballads of the period of French history Charles Martel and Charlemagne are frequently spoken of indiscriminately.

**CHARLES THE BOLD** (1433-77), Duke of Burgundy, was born at Dijon in France Nov. 10, 1433, the son of Philip the Good of Burgundy and Isabella of Portugal. Philip the Good ruled over territories extending from the valley of the Saone to the North Sea and cut in two by the province of Lorraine. Charles the Bold therefore set himself the task even before his father's death of consolidating his possessions by conquering Lorraine. He even dreamed of having himself crowned King by the Emperor and thus establishing a new kingdom between France and Germany. In these projects he had to meet the hostility of Louis XI of France, who bent all his efforts to frustrate the plans of his powerful vassal. The Emperor also, 1467, refused the crown to Charles. Of an honest, forthright character, Charles was no match for the wily and circuitous Louis XI. He was kept constantly embroiled and was finally killed by the Swiss in the battle before Nancy, Jan. 5, 1477. His daughter Mary married the Emperor's son Maximilian, and it was this marriage that ultimately resulted in bringing the possessions of Charles the Bold in the Netherlands into the hands of Charles V of Austria, the grandson of Mary and Maximilian. Meanwhile Louis XI of France seized the opportunity of reclaiming part of Burgundy.

**BIBLIOGRAPHY.**—R. Putnam, *Charles the Bold, last duke of Burgundy*, 1908.

**CHARLES THE GREAT** (c. 742-814), or Charlemagne, Frankish King, was the son of that Pippin whom Pope Stephen II anointed King of the Franks, conferring upon him and his two sons the title, "Patricians of the Romans." On the death of Pippin in 768 the kingdom was divided between his sons Charles and Carloman. On the death of Carloman three years later Charles became sole King, excluding his infant nephews from the succession.

Throughout his reign Charles was engaged in intermittent warfare. Within the kingdom he had the task of actually subduing the peoples whom his father and grandfather had brought under nominal control. Beyond the Frankish borders were hostile neighbors, at whose expense Charles very materially extended his dominions. Married to a Lombard princess, he soon repudiated her, and later at the Pope's request made war on his father-in-law, King Desiderius. With the reluctant support of his nobles he succeeded in de-throning Desiderius, and made himself King of the Lombards in 774. In 778 he crossed the Pyrenees to interfere in a struggle between two rival Moslem factions. Obligated to beat a hasty retreat, his rear guard was attacked and annihilated by Gascons in the valley of Roncesvalles. Among the slain was a Breton count, Roland. This relatively unimportant episode formed the basis for the famous medieval epic, *The Song of Roland*. Charles's chief military exploit was the conquest of the fierce Saxon tribes east of the Rhine, a task achieved only after 33 years of successive cam-



paigns, and ending in the adoption of Christianity by the vanquished. Other wars brought under his control most of Italy, Pannonia, Dacia, Istria, Liburnia and Dalmatia. In the words of his friend and biographer, EINHARD, "he vanquished and made tributary all the wild and barbarous tribes dwelling in Germany between the Rhine and the Vistula, the ocean and the Danube."

To govern this vast empire Charles extended the Merovingian system of administrative districts, placing over each district an official bearing the title of count. Some of these "counties," especially those on the frontier, were organized in groups under a duke, who was given wide governmental powers. To preserve some measure of centralized control Charles made use of another Merovingian institution, the *missi dominici*, or royal messengers. These usually traveled in pairs, a churchman and a layman, and were empowered to administer justice, maintain roads and bridges, and hear complaints in the local popular assemblies over which they presided. Each year the King summoned a Diet composed of freemen, and a smaller assembly of the chief nobles. Both assemblies had only advisory functions. From time to time Charles issued capitularies, or decrees, which had the force of law. Criminal law was revised in such a way as to enhance the royal power and prevent feuds. The King received a proportion of the fines levied in the courts; the remainder of his revenue came principally from the royal estates and "free gifts" from his officials. He required detailed annual reports from the stewards of his estates. At first each freeman was required to serve in the army, furnishing his own food and equipment for a specified time. Under the empire this duty was limited to those who held about 600 acres of land or more.

Although nearly illiterate, according to modern standards, Charles was an enthusiastic supporter of education. At his capital, Aachen, he established a school for the sons of nobles, later admitting promising youths of humbler birth. As teachers he summoned the most learned men of the day, chief of whom was the Englishman, ALCUIN. Bishops and abbots were required to found schools in their cathedrals and monasteries. His avowed purpose was to preserve and increase "the wisdom for understanding the Holy Scriptures." While the actual results achieved were small, they mark the beginning of a new intellectual interest which was to bear fruit in educational development in succeeding centuries.

By the end of the century Charles was supreme in the West. The eastern emperors were steadily losing their slight hold on Italy, and were wholly unable, or at least unwilling, to assist the papacy in its local difficulties. Moreover, the eastern emperors were suspected of heresy, and the East was steadily separating from the West ecclesiastically and culturally. In Constantinople IRENE had blinded her son, Constantine, and usurped the empire. Many were of the opinion that a woman could not legally occupy the imperial throne, and that hence it was vacant. The papacy

needed a strong secular power for support; Charles needed papal sanction for his political ambitions. In 799 Pope Leo III, menaced by a Roman uprising, took refuge with Charles, who crossed the Alps and restored him to the papal throne. On Christmas Day 800, while Charles was attending mass at St. Peter's, the Pope placed a crown upon his head and proclaimed him Emperor. Einhard's statement that the coronation was contrary to Charles's desires can scarcely be accepted. At most, Charles may have felt that the Pope's action was premature. The title added nothing to Charles's power, but increased his prestige. He was eventually recognized as Emperor by the Byzantine ruler, as well as by the Caliph of Bagdad. On his death, Jan. 28, 814, he was succeeded by his only surviving legitimate son, Louis the Pious.

W. I. B.

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**CHARLESTON**, a city in eastern Illinois, the county seat of Coles Co., 40 mi. west of Terre Haute, Ind. It is served by bus lines and two railroads. Grain and broom corn are the chief crops of this region, and the city has broom and shoe factories and railroad shops. Charleston is the seat of Eastern Illinois State Teachers College. Abraham Lincoln practiced law here. Seven mi. south is the site of Lincoln's log cabin. Charleston was founded in 1831 and incorporated about 1835. Pop. 1920, 6,615; 1930, 8,012.

**CHARLESTON**, a seaport and the county seat of Charleston Co., is situated on the coast of South Carolina. The city lies between the mouths of the Ashley and the Cooper rivers which empty into the beautiful Charleston Harbor. Bus and steamship lines and three railroads serve the city. There is a municipal airport and also one connected with the Navy Yard. Charleston is the headquarters of the Sixth Lighthouse District. Cotton and vegetables are the chief crops of this region. The principal industries are gasoline refining and the manufacture of textiles, fertilizers and cigars. In 1929 the value of the factory output reached a total of \$32,574,467; the retail trade amounted to \$24,670,541. Charleston shipped the first bale of cotton from this country to Europe. The city exports cotton, tobacco, lumber and vegetables. Since 1920 the shipping business has more than doubled. During a short period of prosperity, 1920-1928, much construction work was accomplished. Two new hotels were built and two splendid new bridges; one spanning the Ashley and the other the Cooper River, connecting up the coastal highways north and south. The Citadel, the South Carolina State Military College, and the South Carolina Medical College, besides the College of Charleston, one of the oldest colleges in the United States, are located here.

Charleston's first permanent settlement was made by the English about 1670 and was called Charles Town for Charles II. The French Huguenots came

about 1680. In 1755, 2,000 Arcadian refugees arrived. In 1783 the city was chartered. During the American Revolution it was captured by the British. In 1861 the first shot in the Civil War was fired on Fort Sumter from batteries in the harbor. In 1865 the city suffered from the vandalism of the invading Northern Army. In the earthquake of 1886 about 27 people were killed, many more injured and about \$5,000,000 worth of property was destroyed.

Rebuilt, Charleston is to-day a city of unique charm with fine old houses of a peculiarly local style of architecture. St. Michael's Church, St. Philip's Church, the Huguenot Church, the Market and the Powder Magazine are among the most interesting old buildings. The city has become a winter resort for tourists and a place of inspiration for artists and writers. Pop. 1920, 67,957; 1930, 62,265.

**CHARLESTON**, the capital of West Virginia, a city in the western part of the state, the county seat of Kanawha Co. It is situated on the Great Kanawha River at the mouth of the Elk, 366 mi. northwest of Richmond. Bus and truck lines, river craft and four railroads serve the city. Charleston lies in the heart of a region producing coal, natural gas and oil. It has such local manufactures as chemicals, steel and glass. In 1929 the factory output amounted approximately to \$16,000,000; the retail trade amounted to \$41,720,427. The United States Naval Ordnance plant is located in Charleston. The new capitol is a splendid edifice. Charleston was founded in 1788 and incorporated in 1870. Pop. 1920, 39,608; 1930, 60,408.

**CHARLESTON, BATTLE OF**, June 28, 1776, one of the chief battles of the REVOLUTIONARY WAR. In Jan. 1776, Sir Henry Clinton was dispatched from British headquarters at Boston with 2,000 troops, to hold the southern colonies for the Crown. Discovering that he would encounter formidable opposition, Clinton cruised along the Carolina coast, not risking a landing. At Cape Fear he was joined by Sir Peter Parker with 10 ships and seven regiments from England; the forces combined for an attack upon Charleston. Edward Rutledge, chief of the provisional, or Patriot, government in Charleston, mustered about 6,000 militia; Col. Moultrie strengthened the fortress on Sullivan's Island to prevent the enemy's entering the harbor. The British fleet, throughout the day of June 28, bombarded the fortress; its sand and palmetto works were little harmed. Clinton attempted a diversion, landing 2,000 troops on a sandbank and attempting to reach Sullivan's Island by wading an inlet; but the inlet proved an impassable morass. After 10 hours' bombardment, costing the British over 200 casualties and inflicting inconsiderable loss upon the Americans, the fleet sailed away. The southern colonies were unmolested until the late autumn of 1778.

**CHARLESTON, SIEGE OF**, 1863-65, an operation of Federal forces, naval and land in the CIVIL WAR. On Apr. 7, 1863 the fleet of nine ironclads under Admiral Du Pont attacked the defenses of

Charleston harbor. Imperfect steering apparatus disarranged the line of battle; sunken obstructions impeded the ironclads, and Du Pont retired. He was succeeded in command by Admiral Dahlgren, who, with the cooperation of land forces under Gen. Gillmore, laid siege to Charleston on July 6. Misled as to the topography of the lands about the harbor, the Federal troops moved into an untenable position, and were repulsed with heavy loss. Gillmore's troops erected batteries bearing upon Ft. Sumter and the city of Charleston, and began a vigorous attack on Aug. 19, in concert with the fleet. Ft. Sumter was reduced to ruins; Ft. Wagner was evacuated on Sept. 7. The harbor was successfully held. Gillmore's force was too small to attempt the occupation of Charleston, and the city remained in Confederate hands, until evacuated by Gen. Hardee, Feb. 17, 1865, when Gen. Sherman invaded South Carolina.

**CHARLOTTE**, a city in southern Michigan, the county seat of Eaton Co., situated 18 mi. southwest of Lansing. Bus lines and two railroads afford transportation. The city is a trade center for the dairying and farming district, raising principally beans, corn, wheat, oats and beets. The local manufactures include furniture, radios, caskets and road machinery. Charlotte was founded in 1838. Pop. 1920, 5,126; 1930, 5,307.

**CHARLOTTE**, a city of southern North Carolina, the county seat of Mecklenburg Co. It is situated in the industrialized Piedmont district, 68 mi. southwest of Winston-Salem. Four railroads, bus and truck lines and an airport serve the city. Charlotte is one of the important industrial centers of the south. Textiles, dye stuffs and several kinds of machinery are the chief products. In 1929 the total factory output was worth about \$57,000,000; the retail trade amounted to \$47,416,230. The city is a distributing market for automobiles and automobile parts. The surrounding country produces, cotton, tobacco, peanuts and truck crops. Queen's College for Women, 1771, and the Johnson C. Smith University for Negroes are situated here. Charlotte was founded in 1750 and incorporated in 1768. CORNWALLIS occupied the city in 1780. The final meeting of JEFFERSON DAVIS's cabinet was held in the city. Pop., 1920, 46,338; 1930, 82,675.

**CHARLOTTE DUNDAS**, a paddle wheel steamer built in 1802 by W. Symington for towing on the Forth and Clyde Canal, Scotland. The engine was of the horizontal type and was built by JAMES WATT. See also SHIPBUILDING, HISTORY OF.

**CHARLOTTENBURG**, a German city, a part of Greater Berlin since 1920. It begins on the west side of the Tiergarten. It was founded by Queen Sophie Charlotte of Prussia, whose statue, with her husband's, is at the foot of the Charlottenburg Bridge. It has a former royal palace built in the 17th century. Nearby is the mausoleum where lie Frederick William III and Queen Louise, Emperor William I and Empress Augusta. It has an imposing institute of technology and art and music academies, built in the ornate style of the '80s and '90s. Its industries in-

clude porcelain factories and iron works. Pop. 1925, 345,140.

**CHARLOTTESVILLE**, a city near the center of Virginia, the county seat of Albemarle Co. It is situated on the Rivanna River, 70 mi. northwest of Richmond and served by airplanes, bus lines and three trunk line railroads. The region produces fruit, wheat and livestock; the local manufactures include silk, woolen textiles and underwear. In 1929 the factory output reached an approximate total of \$4,000,000; the retail trade in 1929 amounted to \$11,661,002. Charlottesville is the seat of the University of Virginia, founded in 1817 by Thomas Jefferson, who was one of the first trustees. It is the birthplace of Merriwether Lewis and George Rogers Clark. The city, set in the beautiful Blue Ridge Mountains, was patented in 1737 and named for Queen Charlotte. During the Revolution British troops who surrendered at Saratoga were quartered here. The city was raided by the British under Sir Banastre Tarleton in 1781. Monticello, home of Thomas Jefferson; Ashlawn, home of James Monroe, and Michie Tavern, the home of Patrick Henry, are interesting landmarks. Pop. 1920, 10,688; 1930, 15,245.

**CHARLOTTETOWN**, a port of Canada and the capital of Prince Edward Island, well-situated on the southern coast of Queen's Co., on the Hillsborough River which, with the York and Elliott rivers forms an excellent harbor, about 117 mi. directly north of Halifax. It is the focal point and headquarters of the Prince Edward Island division of the Canadian National railroads, and chief port of Prince Edward Island. Charlottetown maintains constant steamer communication with northern Atlantic ports, extensively exporting farm produce and the catch of large and important fisheries. Woolens, canned goods, foundry and lumber products are manufactured. The city is regularly and spaciouly planned, with fine government buildings, many churches and parks. The provincially supported Prince of Wales College is among the educational institutions. Founded by the French in 1750 as the fort, Port la Joie, Charlottetown became British in 1768 and was named in honor of George III's queen. Pop. 1921, 10,814; 1931, 12,357.

**CHARLOTTETOWN CONVENTION**, 1864, in Canadian history, an assembly of great importance in the movement for confederation. A motion by Charles Tupper in the assembly of Nova Scotia for a legislative maritime union prompted a call for a convention of the maritime provinces to meet Sept. 1, 1864, at Charlottetown, Prince Edward Island. Advocates of federation in United Canada asked and secured permission for a Canadian delegation. Eight Canadians, including SIR JOHN MACDONALD, GEORGE BROWN, SIR GEORGE CARTIER and Galt, accordingly participated with delegates from Nova Scotia, New Brunswick and Prince Edward Island. The Canadian delegates opened the proceedings with arguments in favor of a British North America; the Maritime delegates then discussed their local problems, but Nova Scotia only was found prepared to fully sup-

port the plan which had prompted the convocation. The Canadians' plan, involving less loss of provincial prerogatives, was more generally favored, and arrangements were made to call the QUEBEC CONVENTION.

**CHARM**, the most general term for objects, formula, or ceremonies to secure good fortune and avoid evil fate. More special terms are AMULET and TALISMAN. Although watch-charms are still worn, they are now only decorations and are not endowed as in older beliefs with protective qualities enabling their wearer to lead a charmed life. Charms in the old sense imply a mystical or magical property and belong to a world of belief akin to that of primitive man; they survive in folk-lore practices. They give rise to a great variety of customs and play a part in myths and fairy tales. On the negative side they ward off evil. Charms are akin to spells and give rise to counter charms that break the spells. See WITCHCRAFT.

**CHARON**, in Greek mythology, son of EREBUS and Nox. He ferried the souls of the dead over the rivers of the infernal regions. For this he was paid an obolus, the coin being put in the mouth of the dead. He is pictured as an old man dressed in short tunic and a round cap, and rowing his skiff with one oar.

**CHARPENTIER, GUSTAVE** (1860- ), French music composer, was born at Dieuze, June 25, 1860. He studied at the Lille Conservatoire, receiving a scholarship which enabled him to study, at the Paris Conservatoire, violin with Massart and composition with Massenet. He gained the Prix de Rome with his cantata *Didon*. His best known works are the orchestral suite *Impressions d'Italie* and his opera *Louise*, the latter produced at Paris in 1900. He is the founder of Le Cercle Mimi Pinson, which establishes choral clubs for working-girls.

**CHARR**, the name given in Great Britain to a numerous genus (*Salvelinus*) of fine game fishes of the salmon family (*Salmonidae*), commonly known in the United States as TROUT.

**CHARTER**, an instrument issued by the sovereign authority incorporating a business enterprise, institution, club, bank, municipality or like enterprises, and legally empowering the CORPORATION to act as such. In the case of a business corporation such an instrument is issued to the incorporators by the secretary of state of the state in which incorporation takes place. Also a written contract or convention granting certain property rights or privileges is issued by a sovereign power, in feudal times by the crown and sometimes by the nobles. Royal charters usually applied to grants of land. In American colonial history the charter meant grant of franchise, governmental privileges and estates to companies for the purpose of establishing colonies. Such was the charter of the Massachusetts Bay Colony, of Connecticut and of New York. The Great Charter granted by King John, MAGNA CARTA, led to the association of the word with constitutional privileges and thus it became associated with constitutions granted by the sovereign

powers to the people. The business charter is really a franchise to perform certain acts and to carry on a mercantile or other business enterprise according to the articles of incorporation, setting forth the intent of the corporation when the charter is applied for. Such charters may be rescinded for cause and may be refused if the state is not satisfied with the good intentions of the incorporators or if the articles of incorporation do not comply with the laws of the state in which incorporation is applied for.

**CHARTIER, ALAIN** (c. 1392-c. 1440), French poet and diplomatist, was born at Bayeux, France, about 1392. He was sent on various diplomatic missions to Germany and Scotland. His poems, which deal chiefly with lovers' quarrels, are now largely forgotten, with the exception of the well-known *Belle Dame Sans Merci*. Chartier died in France, about 1440.

**CHARTISM**, a movement of the working class in England, 1838-48, to gain certain political powers and to improve their social conditions. The name is derived from the National or People's Charter, prepared by six workmen and six members of Parliament. Six points for reform were incorporated: manhood suffrage; equal electoral districts; vote by ballot; annual Parliaments; no property qualifications for Parliament members; Parliament members to be paid for their services. Huge meetings were held, physical force advocated, and excited by the fiery oratory of the leaders the people were roused to a frenzy. In May 1839, a National Convention, elected by the Chartists, met in Birmingham. In June 1839 a petition supposedly signed by 1,280,000 persons favoring the Charter, was presented to the House of Commons, which refused to consider it. Riots broke out, particularly in 1842 in the northern and midland districts of England. In Apr. 1848 a great demonstration was scheduled to take place in London. The leaders were intimidated, however, by the armed preparation of the government, and the result was a dismal failure. From this year Chartism declined. The repeal of the CORN LAWS and the great industrial expansion of England did much to better the conditions of the working class. Among the Chartist leaders were Feargus O'Connor, Attwood, Lovett, Stephens, Vincent, Ernest Jones and Thomas Cooper.

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**CHARTRES**, a town of the Ile-de-France, 55 mi. southwest of Paris, famed for its Gothic cathedral. The town has several fine old houses, a picturesque 14th century gate, and another good 13th century church, St. Pierre, with rich Limoges enamels. Chartres is the capital of the department of Eure-et-Loir, and the market for the Beauce grain country in which it is situated. Pop. 1931, 25,357.

The Cathedral of Notre Dame at Chartres is often considered the most beautiful of French Gothic cathedrals. Although it owes this position of pre-eminence to its rare excellence as a complete whole, it is likewise unsurpassed in many of its details. The

purity of its design, the singular perfection of its dissimilar spires, the spiritual quality of its 12th century sculpture, and above all the incomparable magnificence of its stained glass, unite to make the cathedral of Chartres a masterpiece.

Tradition states that on this site the Druids worshiped a virgin who should bear a child. Of the present church, the crypt survives from a structure of the 11th century.

The earliest existing work above ground is the severe but beautiful west front, set back between the two towers, which is all that remains of the 12th-century cathedral destroyed by fire in 1194. In this façade are found three exquisite lancet windows of the 12th century, one of which represents the Tree of Jesse. The three portals which originally formed a narthex are decorated with statues that marked a new step in the medieval development of sculpture. Of an early period also is the southern spire, the plainer and more exquisitely symmetrical of the two noted spires of Chartres, and well described by Henry Adams as "the flèche of all flèches." The other spire, beautifully designed and almost as perfect, was added in 1507-13, and is an extraordinary example of pure Gothic of the 16th century.

The main body of the present cathedral was completed by 1210, and the north and south porches were probably added in 1210-40. These portals, more ornate than those of the west front, are also elaborately sculptured. Two chapels were built at later periods, and in the 16th century the chancel was surrounded by a richly carved screen. In the 18th century the choir was altered with bad effect. The cathedral remains, however, simple in plan and relatively unburdened with interior ornamentation. The stained glass of Chartres, dating chiefly from early in the 13th century, is unequaled. The windows number about 175 in all. In conjunction with the solemn splendor of the structure the superb color of these ancient windows creates an effect of beauty that is unique. Chartres, in its building, was a cathedral of the people, and many of the magnificent windows were gifts from medieval guilds.

**CHARTS AND GRAPHS**, conventionalized diagrams, other than mechanical drawings, illustrating relationships of magnitude, of position, of time or of combinations of these elements. Their chief value lies in the quickness with which they stimulate the imagination through the creation of mental impressions of relative size or position. Diagrams can also be specially designed for making computations. See **GRAPHICAL METHODS**.

Charts are used chiefly to analyze tabular data gathered in research, to aid management in recording and controlling business operations and to aid in the presentation of facts. Graphs are curves constructed by connecting points whose positions are determined relative to two straight lines or scales intersecting at right angles. Many mathematical equations can be readily represented by such curves. Gantt charts, named after Henry L. Gantt (1861-1919), an

industrial engineer, are used to compare results accomplished during regular intervals of time with scheduled tasks or quotas.

The graphic method of presentation permits of considerable latitude in choosing the type of chart. Simple comparisons of magnitude may be shown by rectangular bars of constant width arranged in parallel, either vertically or horizontally, their lengths proportional to the given figures. To show component parts, rectangular bars may be divided into segments, or in pie diagrams, circles may be divided into sectors of the requisite proportions. In map representations and in component part diagrams special markings or crosshatchings are often used to identify the several areas.

Although simple comparisons of magnitude with time as a variable factor may be illustrated by vertical rectangular bars, more complex comparisons can best be shown by means of graphs in which the horizontal line of reference is a scale representing the flow of time. Specially ruled paper facilitates the construction of such graphs.

In ratio charts the comparison of relative or proportionate changes is facilitated through the use of ratio or logarithmic scales for measuring vertical distances while the customary uniformly spaced or arithmetic scales are used for horizontal distances. Graphs thus drawn possess the valuable property that equal percentage fluctuations are invariably represented by equal vertical changes regardless of whether the curves are near the top or the bottom of the diagram.

E. T. F.

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**CHARYBDIS**, in Greek mythology, the sea monster who lived on the rock opposite Scylla near Sicily. SCYLLA lived in a cave in the rocks near Italy. The passage between was dangerous to sailors because of these two monsters. Charybdis was a whirlpool which swallowed the waters of the sea and spouted them out again three times daily.

**CHASE, HARRY WOODBURN** (1883- ), American educator, was born at Groveland, Mass., Apr. 11, 1883. He was educated at Dartmouth and from 1909-10 was director of the clinic for subnormal children at Clark University. In 1910 he became associated with the University of North Carolina where he served as professor of the philosophy of education from 1910-14, professor of psychology from 1914-19, and president from 1919-30. Chase became president of the University of Illinois in Feb. 1930.

**CHASE, JOSEPH CUMMINGS** (1878- ), American artist, was born at Kents Hill, Me., May 5, 1878. He studied at the Pennsylvania Academy of Fine Arts, Philadelphia, and at the Académie Julian, Paris. During American participation in the World War he was official portrait painter with the A.E.F., painting portraits of Gen. Pershing, Marshal Foch and others. Fifty of his portraits were placed in the permanent collection of the National Gallery,

Washington, D.C. In 1929 he joined the faculty of Hunter College of the City of New York as professor and head of the art department. His publications include *Decorative Design*, 1915, *Drawing*, 1916, *Romance of an Art Career*, 1928, and *An Artist Talks About Color*, 1930.

**CHASE, SALMON PORTLAND** (1808-73), American statesman and lawyer, was born at Cornish, N.H., Jan. 13, 1808. He was educated at Cincinnati College and at Dartmouth, where he graduated in 1826. For three years he was principal of a boys' school at Washington, D.C., studied law in his spare time, and in 1829 was admitted to the bar. The following year he went to Cincinnati, where his championing of the anti-slavery cause in several important law suits soon brought him into prominence. Chase took an active part in the founding of the short-lived LIBERTY PARTY in 1840, and in 1848 presided at the Free-Soil national convention which nominated MARTIN VAN BUREN for the Presidency. Through a fusion of Democrats and Free-Soilers, Chase was elected in 1849 to the U.S. Senate, where he opposed the compromise bills in 1850, and the Kansas-Nebraska bill four years later. In 1855 he was elected governor of Ohio as a Free-Soil Democrat and won reelection in 1857 as a Republican. Chase again became United States Senator in 1860 but resigned the next year to enter Lincoln's cabinet as Secretary of the Treasury. During this most difficult period, when the national treasury was constantly emptied by the huge costs of the Civil War, and confidence in the government reached its lowest ebb, he proved himself a financial genius by his brilliant handling of the situation. He reestablished the public credit upon a sound basis, created a currency corresponding to the needs of the war, put into operation machinery for increasing internal revenue, and projected the national bank system still in use. Owing to a disagreement with the President over matters of patronage, Chase resigned from the Cabinet in July, 1864, but the following year, at the death of Chief Justice R. B. TANEY, he was nominated Chief Justice of the U.S. Supreme Court by Lincoln, holding that post until 1873. As Chief Justice he presided at the Senate trial of the impeachment of President A. JOHNSON in 1868. He died at New York, May 7, 1873.

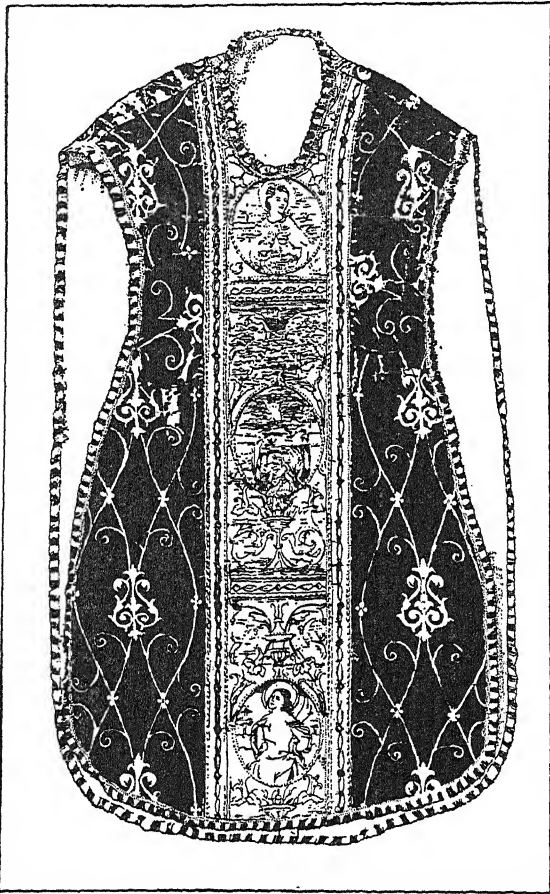
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**CHASE, WILLIAM MERRITT** (1849-1916), American painter of portraits, landscapes and still life, was born at Williamsburg, Ind., Nov. 1, 1849. Exhibiting unusual talent at an early age, he studied in Indianapolis, New York and St. Louis. At 23 he was sent abroad to study in the Royal Academy at Munich, one of his teachers being Piloty. Returning to New York in 1878 he taught at the Art Students' League, opened a studio and quickly rose to the foremost ranks of American artists, specializing in portraiture and still life. In the latter class he was notably successful in painting fish. He was for years a beloved and inspiring teacher, conducting classes in New York, at an art colony established by



him on the Shinnecock Hills near Southampton, Long Island, and in 1914 at Carmel, Cal. Among his notable portraits are those of Whistler and *A Lady in Black* in the Metropolitan, and *Alice* in the Chicago Art Institute. For 10 years Chase was the president of the Society of American Artists. He died in New York City, Oct. 25, 1916.

**CHASING**, the process of decorating metal work, especially silver and gold, by tooling on the right side or exterior. Usually, however, it is understood to include the repoussé work, the tooling from the under side, or interior, with which it is closely associated. The chasing tools are chisel, graver and burin, applied by delicate strokes of a wooden mallet. The chief tool for the repoussé work, which must be done first, is the snarling-iron, a long iron bar ending in a roundish knob. When the knob is held against the interior



COURTESY M. M. OF ART

CHASUBLE WITH ORPHREYS EMBROIDERED IN GOLD ON A GROUND OF EMBROIDERED VELVET  
Italian, 16th century

of a vase or other vessel, a quick sidewise blow on the handle will cause a bulge in the thin sheet metal. To prepare for the finishing work of the chaser, a vessel must be filled with pitch, or a flat sheet of metal laid on a pitch-block, for an elastic cushion. The art of chasing, including the repoussé work, has been prac-

ticed from remote antiquity in nearly all civilized countries.

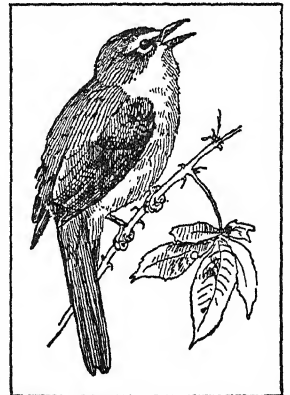
**CHASTACOSTA**, an Athapascan-speaking group of villages formerly on the Rogue River in Oregon. In the middle of the 19th century, following warfare with neighboring whites, they were removed to the Siletz Reservation in Oregon, where they now live, engaging in fishing, berrying and hop-picking.

**CHASTE-TREE** (*Vitex Agnus-castus*) a handsome, strongly aromatic plant of the vervain family, native to southern Europe and cultivated as an ornamental. It is a gray, woolly shrub or small tree, about 10 ft. high, bearing velvety compound leaves of 5 to 7 leaflets. The showy, somewhat tubular, pale blue or lilac flowers, borne in dense clusters about 6 in. long, bloom in late summer or autumn.

**CHASUBLE** (Latin *casula*, *casubula*), the principal Mass vestment of the priest, covering all the other vestments. Originally it was a wide, armless, bell-like cloak, which enveloped the priest like a little house (*casula*) with an opening for the head. In earliest times it had woven and embroidered stripes along the edges and was later provided with cords on the shoulders to pull up the chasuble above the hands. Only toward the end of the Middle Ages were the sides cut to make room for the arms. The material is usually costly and ornamented with appropriate designs. In early medieval times, the color of the chasuble was dark yellow or yellowish green, later also red and dark violet, usually without ornamentation in other colors. After the 11th century it was provided with gold-embroidered stripes (*aurifrisae*), which formed in front and back a Y cross, or sometimes the conventional form of a tree with branches.

**CHAT**, a name given to a numerous group (*Saxicolinae*) of Old World birds of the thrush family.

They comprise about 10 genera and more than 100 species somewhat resembling the flycatchers in their habit of capturing their insect food by short flights from a fixed perch. Among the best known are the whinchat (*Pratincola rubetra*) and the stonechat (*P. rubicola*), both active restless birds uttering short, sharp call notes. The yellow-breasted chat (*Icteria virens*), widely distributed in North America, is not a true chat but belongs to the wood warbler family (*Compothlypidae*), of which it is the largest member. It is a secretive brush-lot bird of peculiar habits of flight during the courtship period and versatile song composed of a medley of whistling, scolding, piping and barking calls. Both sexes are olive green above and bright yellow below.



G. M. SUTTON, "BIRDS OF PA."  
J. HORACE MCFARLAND CO. COPYRIGHT

YELLOW-BREASTED CHAT

**CHATEAU.** See CASTLE AND CHATEAU.

**CHATEAUBRIAND, FRANÇOIS RENÉ, VICOMTE DE** (1768-1848), French writer and statesman, was born at St. Malo in Brittany, Sept. 4, 1768. He early abandoned a purposed career in the Church because of skepticism, and at 18 entered the army. Brilliant and restless, he traveled to America in 1791-92 and lived among the savages in the Canadian wilderness. From 1792-1800 he lived in England. His first publication was the *Essay on Revolutions*, 1797. In 1801, soon after his return to France, he published *Atala*, an idyllic story about the love of two savages; with its gorgeous descriptions of nature and its elevated sentiments, this novel marked the transition from French Classicism to Romanticism. A sequel, *René*, appeared the same year. In 1803 Chateaubriand issued *Le génie du christianisme*, a glowing eulogy on the poetic features of Christianity. In that year Napoleon appointed him secretary to the embassy at Rome, and subsequently Minister to Valais, but Chateaubriand resigned his post in 1804. His next important work was the splendid travel book, *Itinéraire de Paris à Jerusalem*, 1811; after its appearance the author was elected to the French Academy. In 1815 he was made a peer of France, in 1822 Ambassador to England, and in 1823-24 Minister of Foreign Affairs. In 1830 he retired from public life, to spend his last years in retirement with Madame Récamier and in writing his autobiography, *Mémoires d'Outre-Tombe*, published in 1849-50. Acclaimed as the most brilliant writer of his day, Chateaubriand died in Paris, July 4, 1848. See also FRENCH LITERATURE.

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**CHÂTEAUROUX**, a manufacturing city in central France, capital of the department of Indre, situated on the left bank of the Indre. The Château Raoul, which gave Châteauroux its name, was built in its present form in the fourteenth and fifteenth centuries and is now used for public purposes. The manufacture of sheets and linen goods forms the chief local industry. Pop. 1931, 26,707.

**CHÂTEAU-THIERRY, BATTLE OF**, a severe action in the WORLD WAR, being a part of the conclusion of the German offensive of 1918. The battle is noteworthy as one of the earliest demonstrations of the resourcefulness of American troops, whose fitness for trench warfare was frankly questioned by Allies and Germans alike. In the course of his last offensive, Ludendorff on July 15 succeeded in crossing the Marne, and occupying Château-Thierry, the center of a German salient extending north to Soissons, and east to Rheims. The new 3rd American division, commanded by Dickman, checked the advance beyond Château-Thierry, aided by reserves of the 1st, 2nd, 4th, 26th, 28th, 42nd and 93rd (colored) divisions. On July 18 Foch counter-attacked along the west side of the narrow German salient,

roughly the line Soissons-Château-Thierry, using French divisions with the 1st, 2nd, 3rd, 4th, 26th, 32nd and 42nd American divisions.

The Americans advanced firmly along the 28-mile front, and with French aid drove back the entire German line along the west side. Meanwhile, British, Italian and French divisions were hurled along the southern side, roughly the line Château-Thierry-Rheims, but made only slight gains. Ludendorff, seeing that the salient would be pinched when the Americans met the Allied forces on the southern side, succeeded in holding open the neck of the salient until his divisions moved out of the trap. On July 21 American and French forces reentered Château-Thierry, and the former, continuing the advance east of the town and across the Marne, pursued the Germans to their new front along the Vesle, on Aug. 5 capturing Fismes on the southern bank. The Franco-American "pinching" operation captured 25,000 prisoners and 400 guns.

**CHATHAM**, a municipal borough and port of Kent, England, lying on the Medway 34 mi. southeast of London. The site is prehistoric, and at the time of the Domesday Survey belonged to Bishop Odo. In the 16th and 17th centuries dockyards were established and subsequently enlarged to become the chief naval station in England. The town has grown about the dockyards which now cover 516 acres along the river front. Brickyards, flour mills and lime kilns are located about Chatham, and because of the naval arsenal and military stations it enjoys a large retail trade. Pop. 1921, 42,013; 1931, 42,996.

**CHATHAM**, a city and the capital of Kent Co. and a port of entry of Ontario, Canada, situated on the Thames River, 11 mi. north of Lake Erie, and 186 mi. southwest of Toronto. Having five railroad lines, and water communication with Detroit, Michigan, and Lakes Huron and Erie ports, Chatham is a distributing center for an extensive farming, fruit and tobacco growing section. Hydroelectric power and natural gas are at the demand of the canning, engine and textile factories and lumber planing and flour mills of the growing city. Pop. 1921, 13,256; 1931, 14,569.

**CHATHAM ISLANDS**, a group of three islands and several rocks in the Pacific Ocean, forming part of New Zealand and lying 390 mi. east of New Zealand. The largest of the Chathams is Whairikauri, or Chatham Island. It measures 38 mi. in length, 25 mi. in width and covers an area of 375 square miles. The soil is fertile and there is rich vegetation. Cattle and sheep breeding are the chief industries. Pop. 1926, 562.

**CHATSWORTH**, a parish of Derbyshire, England, and a seat of the dukes of Devonshire. Erected by the 1st duke in 1687-1706 on an older site, and subsequently enlarged, the Palladian mansion is a treasure house of fabulous rooms and great art, TITIAN, HOLBEIN, and RAPHAEL being among the many represented. Known as the Palace of the Peak it overlooks the Derwent amid gardens and fountains rival-

ing those at Versailles. In its 11 mi. of wooded park are an Elizabethan hunting tower and Mary's Bower, an artificial cascade, the favorite retreat of Mary, Queen of Scots when held prisoner at Chatsworth. Across the river is Edensor, a model village established by the 6th duke. Pop. 1931, 250.

**CHATTAHOOCHEE RIVER**, a river of Georgia, rising in the Blue Ridge Mountains in northeast Georgia. It flows southwest to the boundary line between Georgia and Alabama and follows this line to the southern border of the state where it joins the Flint River to form the Apalachicola. It is about 600 mi. long and drains almost all of the north central, middle west and southwest portions of Georgia, an area of 17,000 sq. mi. Steamboats can ascend it to Columbus. Between its source and Columbus the river has a fall of over 850 ft. and supplies extensive water power. The Soque and Chestatee rivers join the upper course of the Chattahoochee.

**CHATTANOOGA**, a city and river port on the southern boundary of Tennessee, the county seat of Hamilton Co. It is situated on the Tennessee River, 138 mi. northwest of Atlanta and is served by several railroads, bus and truck lines and river craft. There is a municipal airport. Chattanooga is an industrial center with more than 400 factories. In 1929 the total manufactured output was worth about \$103,000,000; the chief products include iron, steel castings, farm implements, machinery, iron and clay piping and leather goods. The retail trade in 1929 amounted to \$59,097,880, the wholesale business proper, to \$24,088,973. The city is the seat of the University of Chattanooga and the Chattanooga College of Law. Chattanooga is surrounded by Signal Mountain on the northwest, Missionary Ridge on the east and Lookout Mountain on the south. The vicinity was the scene of the Battle of Chickamauga, on Sept. 19-20, 1863, and the Battle of Chattanooga, Nov. 23-25, 1863, which included the engagements of Missionary Ridge and Lookout Mountain, often called the "battle above the clouds." A national cemetery and a Confederate cemetery are located here. Missionaries came to this neighborhood in 1817. Chattanooga was incorporated in 1851. Pop. 1920, 57,895; 1930, 119,798.

**CHATTANOOGA, BATTLE OF**, Nov. 23-25, 1863, a protracted conflict in the CIVIL WAR between Confederate and Federal armies, ending in the rout of the Confederates. After the BATTLE OF CHICKAMAUGA the Federal army under Gen. Rosecrans was besieged at Chattanooga by the Confederates under Gen. Bragg. The natural defenses just outside Chattanooga, Lookout Mountain and Missionary Ridge were occupied by the Confederates. Gen. Thomas superseded Rosecrans. Grant, lately made commander-in-chief of Union operations in the West, arrived in Knoxville. When the arrival of Gen. Sherman with the Army of the Tennessee brought the Union strength to about 80,000 troops, Grant took the offensive. The first day's attack was devoted to clearing the Confederate army from the plain south of Chattanooga, and was executed by a detachment

under Gen. Granger, aided by artillery fire from the Union forts against the Confederate rifle-pits. The result of the movement was to advance the Federal lines almost a mile. For the operations of Nov. 24-25, see LOOKOUT MOUNTAIN; MISSIONARY RIDGE. Confederate losses in the three days' engagement were 361 killed, 2,160 wounded, and over 4,000 taken prisoners; Union losses were 753 killed and 4,722 wounded.

**CHattel MORTGAGE**, in strictness, a transfer of personal property upon condition to become void if the indebtedness secured by the mortgage is paid at a date fixed, otherwise to remain in full effect. The term is used also of pledges of personal property to secure a debt or obligation, not by way of pawn, but by written instrument or contract. Statutes generally provide for recording chattel mortgages or filing them in some public office, and also fix the procedure for foreclosing them. See also MORTGAGE.

**CHATELS**, generally speaking, any form of property except real estate. For example, a court held, "a bequest of all the testator's chattels will have the same effect as a bequest of all his goods and chattels." Again, the word chattels "will cover the entire personal estate of the testator, unless restrained by the context within narrower limits." Anything from bank bills to crops of corn have been adjudicated chattels. Chattels are divided into personal and real. Personal chattels are movable things, such as animals, garments, books and furniture. Real chattels are estates in land less than freehold, such as estates for years or at will. They are administered as personal property instead of passing to the heir as real property. Crops, however, as peaches and corn, although connected with the land, are personal chattels.

**CHATTERJI, BANKIM CHANDRA** (1838-94), Hindu novelist, was born in Bengal, June 27, 1838. Born a Brahman, he received his degree from Calcutta University in 1858 and became a magistrate in Bengal Province. He began writing novels in the European style and profoundly influenced all subsequent Indian literature. His most famous novel, *Ananda Math*, dealt with an insurrection of 1772 and, though counseling submission to the British rule, contained the hymn BANDE MATARAM which subsequently became the rallying song of the independence movement. Chatterji retired from the civil service in 1891, and died Apr. 8, 1894.

**CHATTERTON, THOMAS** (1753-70), English poet, was born at Bristol, Nov. 20, 1752. While a boy at the Colston Free School his bent of mind was largely determined by some old parchments he found in the Redcliffe Church, Bristol, and he ascribed his writings to a priest whom he called Rowley. Chatterton's brief career is one of the tragedies of literary history. Quitting Bristol and the attorney there to whom he was apprenticed, the poet rented an attic in London in Apr. 1770, but was so poorly paid for his work that he soon faced starvation, and in despair took his own life, Aug. 24, 1770. With the versatility of genius Chatterton wrote remarkably well in

both verse and prose. Among his best-known poems are *The Song of Ælla*, and *The Ode to Liberty*.

**CHAUCER, GEOFFREY** (c. 1345-1400), English poet and the greatest figure in English literature before Shakespeare. He was the son of a wealthy London vintner, who seems to have enjoyed the favor of the royal court. In 1357 young Geoffrey was employed as page in the service of the Countess of Ulster, wife of Prince Lionel, the second son of King Edward III. He was then about 12 years of age. The exact year of his birth is not known, but in 1386, when he appeared as witness in a law suit, he gave his age as "forty years and more." So he must have been born about 1345. The young page was occasionally presented by his mistress with a new suit of clothes or a new pair of shoes and, on festive occasions, with a tip of a few shillings. The bookings of these gifts in the account books are the first records relating to the poet. In 1359 he was in the English army that went across to France, and there, in the course of a raid upon the town of Rethel, not far from Rheims, Geoffrey Chaucer fell into the enemy's hands. On Mar. 1, 1360, the king paid a sum of £16 for his ransom, twice as much as was paid to free a field chaplain. In 1360 he was back in London. The records do not throw any light upon his whereabouts and activities during the next 7 years. In 1367 he is mentioned among the King's esquires, whose task it was to provide entertainment at court. He was evidently married by that time. The records, at any rate, mention a Philippa Chaucer among the ladies-in-waiting of Queen Philippa, whose godchild she seems to have been. She was the daughter of Sir Paon de Roet, a gentleman from Hainault who had come to England in Countess Philippa's retinue when she married King Edward. Sir Paon had another daughter, Catherine, widow of Sir Hugh de Swynford, who was the mistress for more than 20 years of John of Gaunt, and in 1396 became his lawful consort. Through that marriage the poet, towards the end of his life, became a brother-in-law of the Duke of Lancaster. Nothing is known about the married life of Chaucer and Philippa. There is a humorous reference in *The House of Fame* to the unkindly voice that used to wake him in the early morning, but that is the only glimpse he allows us into the intimacy of his home life, and the dedication of his *Astrolabe* to "little Lowys my son" is the only evidence that he was a father. The poet was survived by a Sir Thomas Chaucer, whose monumental tomb may still be seen in the church at Ewelme, Oxfordshire, a 15th-century tradition, now generally assumed to be correct, calls him a son of the poet, but Chaucer himself does not refer in any of his writings to this brother of little Louis. In 1369 the Duchess Blanche, wife of John of Gaunt, died and Chaucer composed an elegy on her death. This is the first of his poems that can be definitely dated. It took the form of a dream vision, a genre much in vogue among French poets of the period, such as Guillaume de Machault and Jean Froissart. French models influenced his work in the be-

ginning of his poetic career, but after 1370 Chaucer came under the spell of Italian literature. He was repeatedly employed on diplomatic missions, and visited Italy in 1373 and again in 1378. On his first Italian journey he may have met PETRARCH, if we may take the words of the Clerk of Oxford in the *Canterbury Tales* as a record of the poet's own experience. In Italy he became acquainted with the writings of DANTE, Petrarch and Boccaccio. Boccaccio especially had a powerful influence on him. His *Troilus and Criseyde*, which he probably wrote in the early '80s, was based on Boccaccio's *Filostrato*, but Chaucer's poem, the first novel in verse in the English language, surpasses its model by deeper insight into character and keener sense of humor. Dante's influence is apparent in *The House of Fame*, an incomplete and enigmatic allegory, in which the personal note is more distinct than in any other of his writings. From Petrarch's Latin translation of the hundredth story of the DECAMERON he took the tale of Griseldis, which is told to the Canterbury Pilgrims by the Clerk of Oxford. In 1374 Chaucer was appointed controller of the customs on wool, hides and skepskins, in the Port of London, at an annual salary of £10, equal to about \$1,500. He moved into the rooms over Algate, near the customhouse where he had his office. There he lived until 1386, in which year he was relieved of his work in the Customs. New and more important offices were assigned to him. In 1385 he was made a Justice of the Peace in Kent and elected member of Parliament for that county. He retained his seat only for a month or two. He was evidently a partisan of King Richard's favorites who, in the fall of 1386, were ousted from power by the Duke of Gloucester. His fortunes rose again in 1389, when the young king asserted himself against his uncle and called John of Gaunt, then waging war in Spain, back to London. Chaucer was made Clerk of the King's Works, which office he held from 1389 to 1391. His discharge was not due to his having incurred the king's disfavor, for in 1393 Richard II made him a gift of £10 as a reward for good service. Thirteen months later the king granted him a pension of £20, and in 1398 he received, at his request, a confirmation in writing of an annual grant that the king had promised him of a butt of wine from the royal cellars: this was Richard's last gift to Chaucer. A year later King Henry IV granted him a pension of 40 marks, in addition to the pension he used to receive from King Richard. Assured of a comfortable old age, he rented from Westminster Abbey a house in the garden of St. Mary's Chapel. The lease was for 53 years, but he lived there for less than so many weeks. In June, 1400, he drew part of his pension for the last time. After that date his name never occurs in the royal accounts. According to the inscription on his tomb in Westminster Abbey, which was erected in 1556, the poet died on Oct. 25, 1400.

The work that Chaucer left behind is a compendium of medieval literature comprising nearly all literary genres: lyrical poetry in a variety of forms, ballades,

roundels, triplets; epic and didactic verse; beast fable, romance of chivalry, saints' legend, fabliau and fairy tale; and in prose, moralizing dialogue, philosophical treatise, scientific manual and pious homily. Opinions vary as to the correct chronological order of these writings. French influences were strongest in his earlier years; in his middle period, from 1373 to 1386, he was under the spell of the Italians; and during the final years of his life, when he wrote the greater part of his *Canterbury Tales*, he may be said to have gone his own English way. But this division into three distinct periods must not be taken too literally. His admiration of the *Roman de la Rose* was as strong in his old age as it was when he translated it into English verse; the French dream-vision poets were his chief inspiration in the Prologue to the *Legend of Good Women*, which he probably composed in 1386, later, in any case, than *Troilus and Criseyde*. For it may be inferred from that Prologue that he had given offense with his story of faithless Criseyde, and the *Legend of Good Women* was to make amends for his slur on womanhood. He retained his admiration of foreign models that had once inspired him; but in the manner in which he utilizes them in his later work he shows a steadily increasing originality.

The CANTERBURY TALES, on which Chaucer probably started work in 1386, is highly original in conception. There is no evidence that the poet knew the *Decameron* of Boccaccio; but even if it could be proved that he did, it would not detract from his merit. For his masterpiece surpasses Boccaccio's storybook in that it brings together a group of narrators representing not one social class, but a cross section of English society. The General Prologue to the Tales, in which he sketches the portraits of his fellow pilgrims, presents a pageant of the English people at the end of the 14th century. If Chaucer had lived to complete his storybook, it could have contained 120 tales, since each of the 30 pilgrims was to tell four stories, two on the road to Canterbury, and two on the way back. The work as he left it contains no more than 24, and three of these, the tales told by the Cook, the Squire and Chaucer himself, he left unfinished. The manuscripts differ in their arrangement of the Tales. The links between the stories, consisting of disputes and quarrels among the pilgrims, contain chronological and topographical data, and the Chaucer Society has tried to rearrange the Tales in such order as would agree with those data. But the result of the attempt was an arrangement that is not confirmed by any of the 60 manuscripts. Chaucer shifted and changed the plan for his poem while the work progressed and had not yet worked out a definite programme at the time of his death. But even in its fragmentary state Chaucer's storybook is one of the great monuments of English and European literature in the Middle Ages. A. J. B.

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**CHAU**, one of the four tribes of the Pawnee confederacy speaking a CADDOAN dialect. Culturally they did not differ from kindred tribes which belonged to the southern Plains culture group. They were semi-sedentary, cultivating maize, around which their important rituals centered, hunted the buffalo, had a series of medicine-men's and other societies, and used both the tipi and a modified earth-lodge. Within the confederacy their head chiefs ranked all the others. They now live on a reservation in Oklahoma.

**CHAULMOOGRA** (*Gynocardis odorata*), a large tree of the flacourtia family, native to farther India. The globular ash-colored fruits, which are about the size of a small orange, contain within their juicy pulp many large seeds. From these seeds is extracted chaulmoogra oil, used in India since ancient times in treating skin diseases and recently employed in the treatment of leprosy.

**CHAUTAUQUA, LAKE**, a lake in Chautauqua Co., western New York, 16 to 18 mi. long extending from Mayville southeast to Jamestown, and from 1 to 2½ mi. wide. It is 726 ft. above the level of Lake Erie, 1,291 ft. above sea level and drains through its outlet Conewango Creek to the Allegheny River and thence via the Ohio and Mississippi to the Atlantic Ocean. The eastern shores of the lake are gravelly and sloping; the western are level and in some places marshy. The village of Chautauqua on the western side of the lake is a well known educational center.

**CHAUTAUQUA MOVEMENT**, a planned and educational community lecture program originating in Chautauqua, N.Y., in 1874. The original program was given in annual summer camp meetings held at Chautauqua and sponsored by the Methodist Episcopal denomination. Gradually the courses of lectures given developed into a summer educational center for religious education. By 1900 there were 200 courses of study, and the courses extended through 10 weeks during the summer. Incidental cultural courses and popular music intended for those unwilling to engage in formal study gradually assumed a predominating importance and attracted as many as 150,000 visitors to Chautauqua annually. Organizations of a similar nature sprang up throughout the country, taking the form of country camp meetings and these local Chautauquas, as they called themselves, all copied the inspirational and cultural program of the parent organization. In 1904 the traveling Chautauqua was initiated, working on the circuit plan. The lecturers and musicians passed from town to town of from 500 to 10,000 population and gave their programs, often in circus tents. There were generally afternoon and evening sessions and the serious lecture was sometimes combined with music and dramatic entertainment. In 1921, when the movement was at its peak of growth, 12,000 local communities were reached with an estimated attendance of five million. It is said that the radio in recent years has contributed to the decline of the Chautauqua movement.

**CHAUVENET, WILLIAM** (1820-70), American astronomer, was born at Milford, Pa., May 24, 1820.



He graduated from Yale and in 1841 became connected with the Naval School at Philadelphia. He influenced the decision to establish a naval school at Annapolis, Md., where in 1845 he took charge of the department of astronomy and navigation. In 1859 he became professor of astronomy at Washington University, and in 1862 was made chancellor. Chauvenet died at St. Paul, Minn., Dec. 13, 1870.

**CHAUVINISM**, a term used to designate a blind unreasoning patriotism that unhesitatingly backs its country right or wrong and usually has in it a considerable element of aggression against foreign countries. The word was coined from the name Chauvin, a wounded French veteran who worshipped Napoleon. Its synonym in vernacular English is jingoism.

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**CHAUX-DE-FONDS, LA**, a town of Switzerland in the canton of Neuchâtel situated in a high valley. The most important buildings include a casino and theater, a watch-making school and high school. The watch industry was founded here and in **LE LOCLE** by Jean Richard, a smith from the Jura Mountains, and the production of the district amounts to 300,000 pieces yearly. Pop. 1930, 35,473.

**CHEB** (German *Eger*), a Czechoslovak city in northwestern Bohemia. It has among others, the Church of St. Nicholas in transition style with two towers, and abbeys of the 13th century. There are remains of the old imperial castle in which **WALLENSTEIN** and his confederates were murdered in 1634. The city hall of 1603 has a museum with relics of Wallenstein. On the quaint market place next to the city hall is the dwelling of **SCHILLER**, who there made his preparations for the Wallenstein trilogy. The manufactures include machines, iron ware, heating plants, textiles, chemical products and miscellaneous commodities, in which there is an active trade. Founded about the 11th century, the Voburg Margrave, Diepold III built a castle there. Emperor Frederick I Barbarossa married Adelheid of Voburg, and Cheb became a free city directly under the emperor. It later changed hands and finally Emperor Ludwig the Bavarian, pledged it to Bohemia in about 1322. The inhabitants are mostly Germans. Pop. 1930, 31,549.

**CHEBOYGAN**, a lake port city in northern Michigan, the county seat of Cheboygan Co., situated on the Straits of Mackinac, 166 mi. northwest of Bay City. Two railroads and lake steamers serve the city. The port is an important fishing center; the total traffic of the harbor in 1929 was valued at \$462,391. The manufactures include lumber products and furniture. The city is a summer resort. Farm crops, fruit and livestock are raised in the vicinity, which also has fox farms. Cheboygan was founded in 1846 and chartered in 1889. Pop. 1920, 5,642; 1930, 4,923.

**CHECK**, an unconditional order in writing addressed by the drawer to a **BANK**, signed by the

drawer, requiring that bank to pay a certain sum in money on demand to a person named, to his order, or to bearer. According to the **NEGOTIABLE INSTRUMENTS** law, it must be dated, unless presented by the drawer himself; it must be drawn on a bank; it must be payable to a person named, to his order, or to bearer; it must specify the sum of money to be paid; it must be signed by the drawer; it purports to be drawn upon a **DEPOSIT**, otherwise it is fraudulent; it is payable in **LEGAL TENDER** instantly on demand. A bank may pay a holder, other than the drawer, in other forms of money, or by means of a **DRAFT** on reserve deposits elsewhere, unless the drawer specifies in the check that the holder is to be paid in legal tender **CURRENCY**. Thus, with respect to its deposits, as evidenced by checks, the bank's unqualified liability is confined to the drawer, the holder having no such claims against it. For its **NOTES**, however, a bank is unqualifiedly liable to any holder for their payment in lawful money upon demand.

Authorities are not agreed as to the origin of the check. H. D. Macleod claims that it was invented by the Romans about 352 B.C. Other writers insist that checks originated in the Middle Ages. It seems well established that checks were used in Italy and Sicily early in the 15th century. They were used in Palermo in 1416, Messina in 1543, Naples in 1573, and Bologna in 1606. In the 16th century their use in Holland became so common that some writers have been inclined to consider Holland the home of the check, despite the earlier uses of the instrument elsewhere. By the latter part of the 17th century they spread to England, and then to the American Colonies, where they were used to a very limited extent, there being evidence of their use in New England as early as 1681.

Today England, the United States, Canada and Australia are the chief check-using countries of the world. It is estimated that approximately 90% of the business transacted in the United States is effected by means of deposit currency, the percentage in England being somewhat higher. In Canada, demand deposits are about four times as important as **BANK NOTES** in circulation, and debits to individual accounts in 1929 had increased 66% over those of 1925, as against about 8% increase in bank notes for the same period. In Australia check payments effect far more than half of the total internal business transactions of that country.

In Germany, where bank notes hold first place in the currency system, the giro or transfer system provides for more deposit transfers than do checks, the latter being of minor importance. In France and Belgium the bank note, because of its elasticity, holds first place, although efforts are being made to develop the use of the check in those countries. The use of the check is not yet highly developed in Italy. Scandinavian countries use checks to a limited extent, as does Japan. In most other countries their use is negligible.

Deposit currency, as evidenced by checks, is the most economical currency yet devised. While checks

have certain virtues and disadvantages when compared with bank notes, their advantages outweigh their defects, which doubtless explains the steady increase in their use throughout the world.

W. E. Sp.

**CHECKERBLOOM** (*Sidalcea malvæflora*), a handsome perennial herb of the mallow family, native to California, and widely cultivated as a border plant. The stems, several in a cluster and about 2 ft. high, rise from a woody root-crown. They bear small,



FROM JEPSON. MAN. FL. PLANTS CALIF.. COPYRIGHT

**CHECKERBLOOM**

Female flowers (left), base of plant, and male flowers (right)

round, toothed or palmately divided leaves and large, showy, rose-colored flowers, 2 in. across, in loose clusters. The variety (*Listeri*) known as "pink beauty" has satiny pink flowers.

**CHECKERS**, a game for two players, using a board divided into 64 squares, generally colored black and white, or black and red. Each player uses 12 men, small and circular in shape, called checkers, or draughts, another name for the game. These he places, one in each colored or white square, at his end of the board. The men can be moved only diagonally and then only when there is a vacant space ahead. If, however, an enemy's man is blocking the way and a vacant square lies beyond, it is possible to jump the man and so remove him from the board. The players aim to advance into their opponent's territory. A man is crowned, by having another man placed on top of him, when he reaches the opposite side of the board; he then may jump forward or backward. To block his opponent so that he cannot make a move is the object of each player.

Checkers is played in many European countries and was known in some form more than 15 centuries before Christ.

**CHECKING ACCOUNT**, a term generally considered synonymous in the United States, with a de-

posit payable upon demand, in contradistinction to time deposits legally payable at the discretion of the bank only after due notice. The time deposits, which do not come within the limits of the checking account, comprise, in the United States, all deposits payable after thirty days, all savings accounts and certificates of deposit which are subject to not less than thirty days' notice before payment, and all postal savings deposits.

In general, the same distinctions hold for other countries in which deposit currency is used, although the term current account is often used in lieu of the expressions, demand deposit or checking account. See also CHECK.

W. E. Sp.

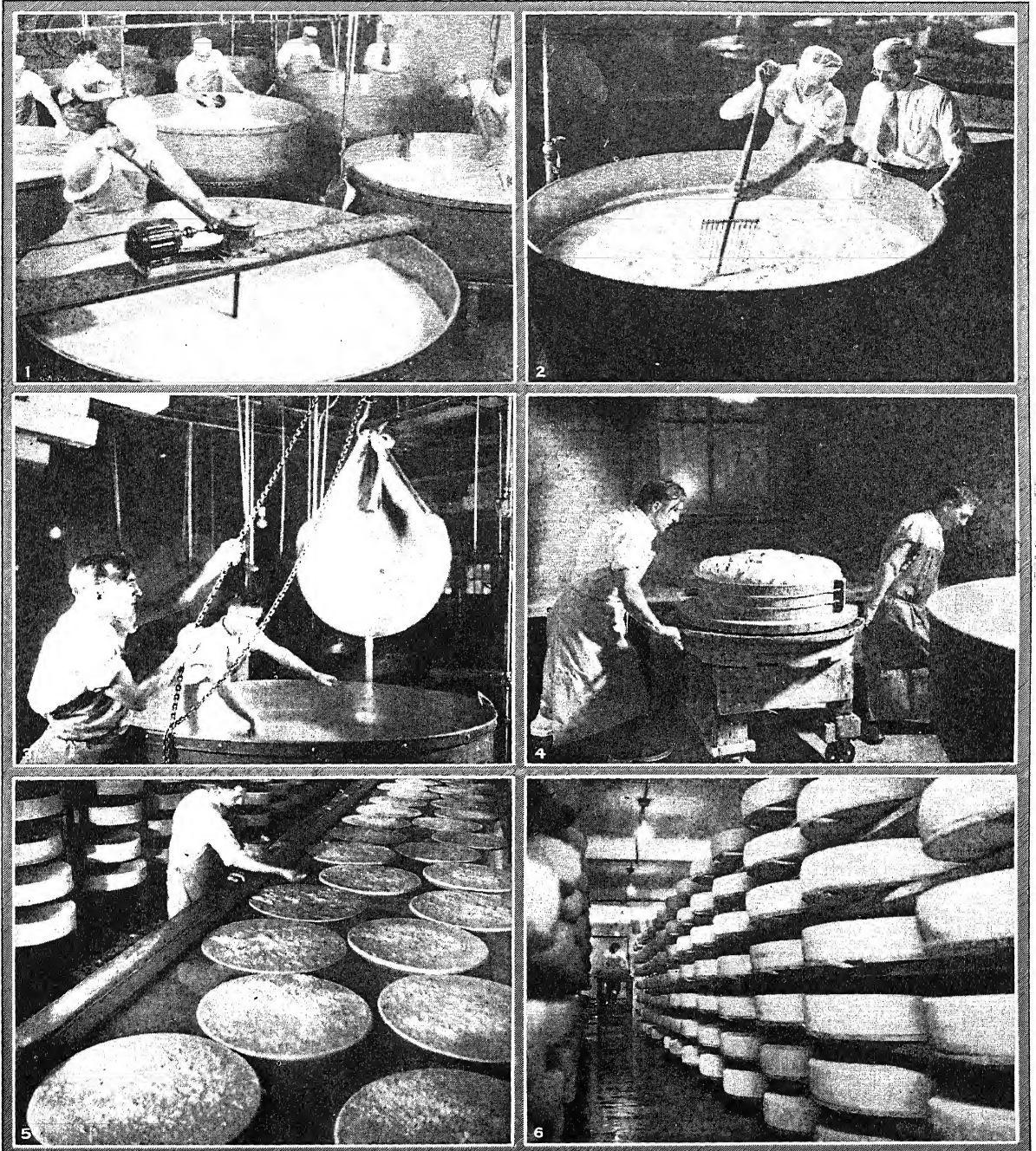
**CHECKS AND BALANCES**, a principle of governmental organization which together with its corollary, the separation of powers, constitutes one of the basic principles of the American plan of government. The objective of both the separation of powers and the system of checks and balances is the prevention of tyranny and the minimization of corruption. The philosophy lying behind these principles is that the concentration of power is the beginning of tyranny. It is imperative, consequently, that power be divided, and hence the Constitution directs the division of the power of government among three organs, executive, legislative and judicial. To further insure against the possibility of tyranny these various branches have given to them certain powers with which to defend their own prerogatives and to check any attempted encroachments on the part of the other divisions.

The Federal Government of the United States may serve as an example of the system in actual operation. To the President have been given the power of executive message, the right to call executive sessions of Congress and most important of all, perhaps, the right of VETO. All of these powers may be used to prevent the growth of any attempted Congressional usurpation. The Supreme Court, furthermore, may use its power to declare a particular law unconstitutional to accomplish the same end. Congress, in its turn, through its control over APPROPRIATIONS, through its power to pass organic acts, and particularly through its power of impeachment, has effective means to nip in the bud any attempted executive tyranny. Here also the courts may play a part, both through writs of CERTIORARI and MANDAMUS, and also by virtue of their power to declare any executive act ULTRA VIRES. The power of the Supreme Court is similarly subject to check, partially through a possible refusal on the part of the executive to enforce its decrees and partially through the power of Congress to impeach. Moreover, appointments to the Supreme Court are made by the President and confirmed by the Senate. The great exponent of the doctrine of checks and balances was MONTESQUIEU. A thorough analysis by American writers is to be found in the *Federalist*.

S. C. W.

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## CHEESE



COURTESY KRAFT PHENIX CHEESE CORP.

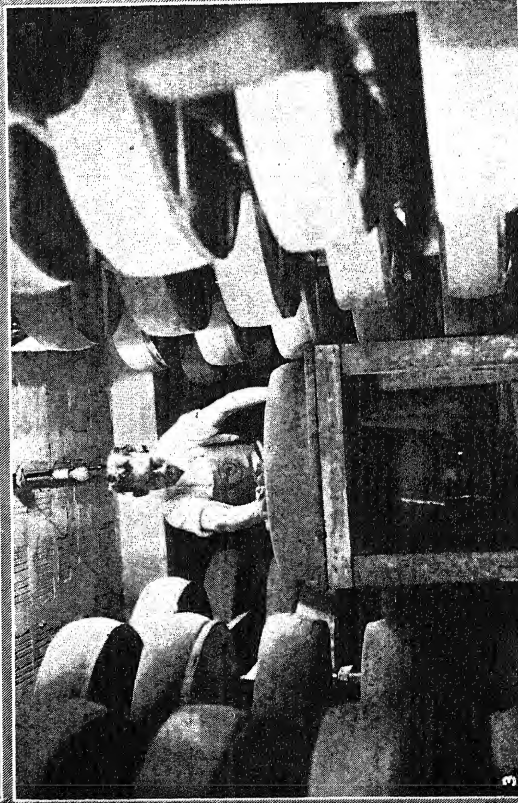
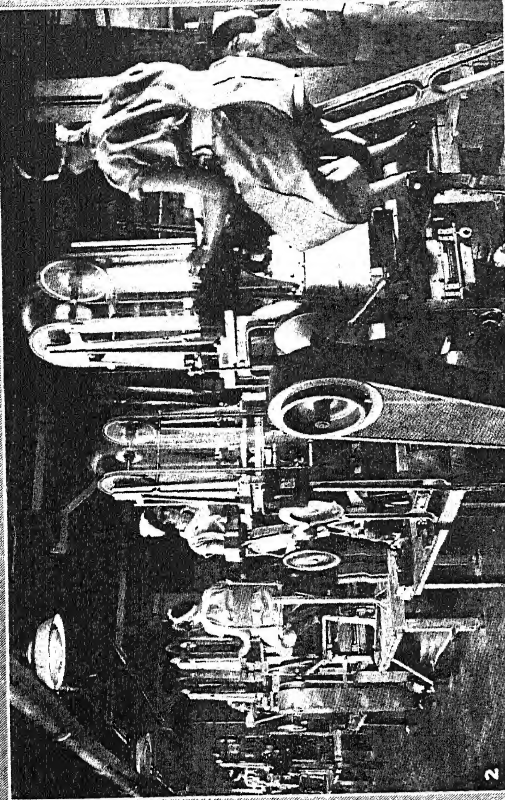
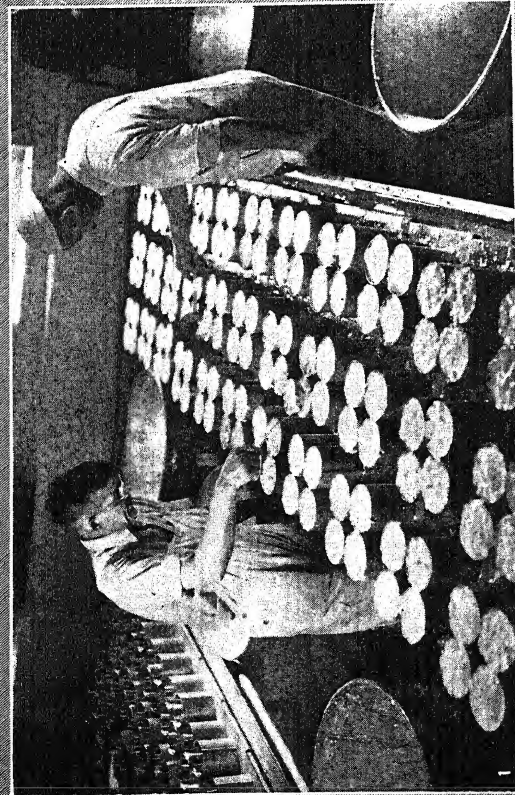
### PROGRESSIVE STEPS IN CHEESE MAKING

1. Many pounds of milk are curded daily in these kettles. 2. The curd is cut into small pieces by the fine wires of this instrument to release the whey. 3. Collecting the curd in specially prepared cheese cloths. 4. The bags of curd are

placed in wooden hoops to allow the whey to drain off under pressure. 5. The cheese is floated for 3 days in a salt solution. 6. Cheese storage room with temperature and humidity carefully controlled.



# CHEESE



COURTESY KRAFT PHENIX CORP., CHICAGO, ILL.

## VARIOUS STEPS IN MAKING FINE CHEESES

1. Ladling curdled milk for Camembert cheese into metal molds. 2. Packaging cheese by machinery.
3. Hand-rubbing each cheese with salt, part of the curing process. 4. "Cave-curing" room where temperature, humidity and ventilation are regulated with scientific accuracy.

**CHEESE**, a product made from the milk of cows, goats, sheep, and other domestic mammals by coagulating the CASEIN with RENNET, an extract of the stomach of young calves, or with acid. The casein, the fat, and some of the sugar and salts, are retained in the cheese curd, but most of the water soluble constituents of the milk are drained off as whey.

In most varieties of cheese the whey is expelled from the curd by draining it in hoops or by pressing for several hours. The finished cheese made from whole milk contains roughly one-third protein (casein), one-third fat, and one-third water. On the basis of their physical characteristics cheeses may be divided into three groups: soft, semi-hard, and hard.

The *soft cheeses* are subjected to little or no pressure and have a higher water content than the hard cheeses. Soft cheeses like cottage, Neufchatel, and cream cheese, are not ripened and have the natural flavor of the milk or cream which is usually modified, however, by a lactic fermentation. Cottage cheese is made from skimmed milk, but cheeses of the Philadelphia cream type are made from milk to which cream is added. The ripened soft cheeses include those ripened by bacteria, such as Limburger and Liederkranz, and such mold ripened cheeses as Camembert, Brie, and ripened Neufchatel. All of these cheeses are made from cow's milk curdled with rennet. Limburger originated in Limburg, Belgium, but is now made extensively in the United States. Camembert, Brie, and Neufchatel are French cheeses, but Camembert is now also made in the United States. They are all small cheeses which ripen in a few weeks.

The best known representatives of the *semi-hard cheeses* are the French Roquefort, the Italian Gorgonzola, and the English Stilton. Roquefort is made from sheep's milk in southern France and is drained without pressure in cylindrical forms, making a cheese weighing 4 to 5 lbs. Gorgonzola is made from cow's milk, a cheese weighing from 15 to 20 lbs. Stilton is also made from cow's milk, but is smaller than the Gorgonzola. All of these cheeses have in common a characteristic sharp flavor and a mottled appearance when they are cut which is due to the growth of mold throughout the cheese. Brick cheese may be classed as a semi-hard cheese but resembles Limburger in its general characteristics and method of ripening.

The *hard cheese* group includes such well known varieties as Cheddar, Swiss or Emmenthal, Edam, Gouda, Parmesan, and Romano. These are all cow's milk cheeses, except that in some of the Italian varieties goat's milk and sometimes sheep's milk are used. The milk is always curdled with rennet and the curd subjected to high pressure to expel the moisture and to form a compact, homogeneous mass.

The cheese most generally made in the United States and frequently called American or cream cheese is a modification of the English cheese which derives its name from the village of Cheddar, where it was first made. The making process is designed to expel the moisture and to form a plastic curd which presses into a firm, homogeneous mass. American Cheddar

is made in various shapes and sizes known as young Americas, longhorns, flats and daisies.

The Swiss or Emmenthaler process differs from the Cheddar method in certain particulars. This cheese is always made in large copper kettles and all of the curd in one kettle is made into a single cheese weighing from 150 to 175 lbs. After the curd is cut it is stirred vigorously and the temperature raised to 125 to 135° F. When the curd has attained the right texture it is dipped from the kettle with a cloth net and put into the press. This process makes a tough, leathery curd.

Nearly all cheeses, before they are ready for consumption, undergo a *ripening process*. They are usually held at a relatively low temperature for two or three weeks for some of the softer cheeses; five or six months for the Swiss, and even one to two years for some of the hard grating cheeses.

In this ripening the curd is changed physically and chemically. The tough insoluble curd is partially changed to peptones, amino acids, and other water soluble products and the fat is hydrolyzed to some extent. ESTERS, ALDEHYDES, AMMONIA and other flavor producing compounds develop. Some of this transformation is brought about by the action of the tryptic ENZYMES natural to the milk and the pepsin introduced with the rennet. However, the characteristic flavors are very largely the result of the activities of micro-organisms.

In Cheddar cheese the lactic streptococci or sour milk bacteria play an important role but the varieties producing the real Cheddar flavor have not been definitely determined. The ripening of Swiss cheese is more complicated. The high temperature maintained in the kettle destroys the lactic streptococci and encourages the growth of certain thermophilic, sugar fermenting bacteria which convert the milk sugar to lactic acid. The cheese is held for the earlier part of the ripening period in a warm room where a new group of bacteria develops and converts the lactates formed by the earlier bacteria to propionic acid. This gives the cheese its characteristic sweetish flavor and the carbon dioxide produced in the fermentation forms the "eyes."

Camembert, Brie, and similar cheeses are ripened by molds which grow on the surface and which, through the action of the enzymes they secrete, partially digest the curd. Roquefort, Gorgonzola and Stilton obtain their flavor from molds which grow in the interior of the cheese. The curd is inoculated with mold when it is put into the hoops and at the proper stage of the ripening numerous small holes are punched in the cheese to admit the air which is essential to the growth of the mold. The ripening is carried out in cold, very moist rooms.

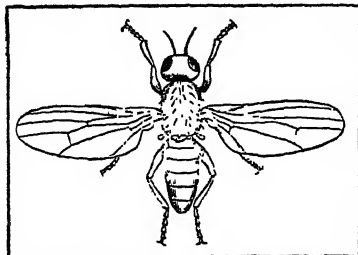
In recent years a process has been developed by which ripened cheese may be melted and molded into any desired form. The cheese is finely ground, a small amount of water and an emulsifying agent, such as sodium citrate, are added. This mass is heated, and gently stirred until it is fluid. It is then run into



forms, usually lined with metal foil, and allowed to harden; cheese so made is often called Process Cheese. See also MILK PRODUCTS. L. A. Ro.

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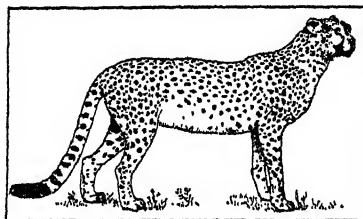
**CHEESE FLY**, a small fly (*Piophilæ casei*), the larva of which infests cheese and also bacon and other



CHEESE FLY  
Enlarged

fatty material. The larva, about  $\frac{1}{8}$  in. long, moves by a series of leaps, whence the name cheese skipper often applied to it.

**CHEETAH** or hunting leopard (*Cynælurus jubatus*), a large cat found in tropical Africa and in Persia, Turkestan and India. In India it is most familiar because of its use there by wealthy natives for hunting antelopes, especially the blackbuck, and other game. Several characteristics distinguish it from the other cats, among them the fact that its claws are short,



CHEETAH OR HUNTING LEOPARD

blunt, almost nonretractile, and the fact that its limbs are long and slim, giving its body a more dog-like aspect and enabling it to run short distances with greater speed than other large mammals. Of about the same length and color as the leopard, it is taller, with spots, not in the form of rosettes, but of solid black, and with an erect crest of hair from head to shoulders.

Assyrian and Egyptian monuments show that even in ancient times the cheetah was employed for hunting. The method employed is akin to falconry. The cheetah, leashed and hooded, is taken in a cart to where the game is awaited. On being released it will either use catlike stealth or give chase. When its fangs sink in the victim's throat and the taste of blood awakens its natural ferocity, some skill is required to draw it off. But once the hood is back over its eyes, it is docile again. The natives make a pet, even a bedfellow, of the cheetah. In the 14th century returning crusaders brought the animal to Europe; in

Italy and France, where hunting with it was considered a noble sport, it continued for 200 years.

**CHEFOO**, treaty port of northeastern China in the province of Shantung. It is situated on a peninsula jutting into the Yellow Sea, and faces Port Arthur. Called by the Chinese Yen Tai, Chefoo has developed from a village into a city with a well-kept foreign quarter. It is also a popular summer resort for colonists in China. The chief trade of the city is in bean cake, Chinese vermicelli, peanuts and silks. Other products are pongee, hairnets, lace, strawbraid and fruits. The Treaty of Tientsin opened Chefoo to foreign trade in 1858. The port has shipped as many as 100,000 coolies to Siberia a year. Pop. 1928, 93,700.

**CHEHALIS**, a city in southwestern Washington, the county seat of Lewis Co. It is situated 68 mi. southwest of Tacoma and is served by five railroads. Timber is the chief product of this region. Pop. 1920, 4,558; 1930, 4,907.

**CHEHALIS**, an Indian tribe now confined to a reservation of the same name in Thurston co., Wash., numbering slightly more than 100 individuals, most of them living on homestead land. Formerly the name was applied to a group of Salish-speaking tribes living along the Chehalis River and its tributaries, and on Grays Harbor, Wash. They appear to have had numerous subdivisions. Chehalis is also the name of a Cowichan tribe of Salish stock, living along the Harrison River in British Columbia.

**CHEIRON** or **CHIRON**, in Greek mythology, the only wise centaur (see CENTAURS). Though half horse and half man, he was instructed in medicine, music, hunting, gymnastics and prophecy, so becoming the teacher of many Greek heroes, including ACHILLES and JASON. During his struggle with the Erymanthian boar, HERCULES was involved in a fight with the centaurs, and one of the god's arrows struck Cheiron, who surrendered his immortality to PROMETHEUS.

**CHEKA**, a secret police organization set up in December 1917 by the Soviet Government to combat counter-revolution, thus the historical heir of the so-called *Okrana*, or imperial political police. The word Cheka is an abbreviation for the Russian *Chrezvychainaya Komissiya*, extraordinary commission. After Dora Kaplan's unsuccessful attack upon VLADIMIR LENIN's life in Sept. 1918, the Cheka abandoned its previous moderation in favor of a reign of terror which lasted three years. Headed successively by Dzherzhinski, Unslicht, Menzhinski, Peters and Ljasis (racially two Poles, a German, and two Letts), it adopted the policy of picking from hostile groups large numbers of hostages who were executed ruthlessly by hundreds whenever the opposition became active. The total number of victims of this terror from all classes of the population aggregates at least three-quarters of a million. In Feb. 1922, the Cheka was superseded by the GPU, abbreviation for the Russian *Gosudarstvennoye Politicheskoye Upravleniye*, State Political Administration, which conducts an

espionage system penetrating all phases of Soviet life and activity, and enjoys all previous privileges of the Cheka, including the right to impose and execute death sentences. The function of the GPU is the protection of the Soviet State from all subversive influences, and it is probably the most efficient branch of the Soviet administration. S. H. C.

**CHEKHOV, ANTON PAVLOVICH** (1860-1904), Russian novelist, playwright and short-story writer, was born at Taganrog, southern Russia, Jan. 17, 1860. He began to write humorous articles in 1879, in that year entering the medical school of the University of Moscow. After 1884 he devoted himself to literature, and began writing the short prose masterpieces, cast often in a humorous and always in a realistic mould, for which he is chiefly famous. Examples of Chekhov's genius in the short-story field are *The Chorus Girl*, 1884, *The Peasants*, 1897, and *The Bishop*, 1902; his most characteristic style is the narration of one or another mental state in the individual, so that character progression is expressed by psychological movement as differing from physical action. He also achieved substantial success in the drama, notably with the plays *Ivanov*, 1887, *The Sea-Gull*, 1896, *Uncle Vanya*, 1899, *The Three Sisters*, 1901, and *The Cherry Orchard*, 1904, all of which except the first, have been repeatedly produced throughout Europe and America.

Chekhov unquestionably was aided in his understanding of the human character by his training in medicine, but apart from his sound physiological knowledge he had a profound sense of human conduct generally, and the relieving humor to make bearable his delineations of man's frailties. He paid little heed to the stagecraft technique of his day; despite this independence his works, notably the plays, lose none of their effectiveness or strength. His two long prose masterpieces are *My Life*, 1895, and *In the Ravine*, 1900. Chekhov died at Badenweiler, Germany, July 2, 1904.

**BIBLIOGRAPHY.**—Constance Garnett, *Letters to his Family and Friends*, 1920; S. S. Kotliansky and L. Woolf, *Note-book of Anton Chekhov*, 1921; W. Gerhardt, *Anton Chekhov*, 1923.

**CHELAMELA**, a small, extinct tribe of the Kalapooian linguistic stock formerly living on one of the western tributaries of the Willamette River in Oregon. Their cultural position is unknown.

**CHELAN, LAKE**, a winding sheet of water about 55 mi. long and from 1 to 3 mi. wide, situated near the center of the State of Washington. It is surrounded by picturesque mountain and glacier scenery, and there is fine fishing and hunting in the vicinity. The numerous resorts along its shores are served by lake steamers. It drains into the Columbia River. The famous Rainbow Falls, 300 ft. high, are located about 3 mi. above the lake.

**CHELIABINSK**, a mining center and railroad junction, and the administrative center of the Cheliabinsk district of the Ural Region of the R.S.F.S.R., situated in the southern Ural Mountain region. It

lies on the express railroad from Moscow to Omsk. Nearby is extensive territory rich in soft coal, a factor which has caused Cheliabinsk to develop rapidly. In 1931 a large tractor plant was under construction. Most of the natives are of Tatar origin. Pop. 1925, 59,397.

**CHELLEAN CULTURE**, the stage of culture placed by the Abbé Breuil in the first Interglacial interval of the Pleistocene period. It is represented by the **PALAEOLITHIC PERIOD**, or Old Stone Age settlement at Chelles-sur-Marne, about eight miles from Paris. The shaping of flint tools by flaking off fragments had been fairly developed. The tool most conspicuous in the Chellean stage generally bears the name *coup-de-poing*, literally "blow of fist." It is a nodule of flint chipped on both faces so as to come to a point at one end, while it is more or less rounded at the other. The tool is thought to have been held in the hand, and used to deliver a blow in hunting or fighting. Often the original surface of the flint at the round end has been left intact. Other Chellean flint implements are borers, scrapers and knives. Where flint was not available, quartzite, limestone, or sandstone was used.

There are many Chellean sites in Belgium, France, Spain, Italy and southern England. Animals characteristic of this stage are two early elephants (*E. meridionalis* and *antiquus*), an early rhinoceros (*R. etruscus*) and a primitive horse (*Equus stenonis*). See **ARCHAEOLOGY**.

**CHELMSFORD**, a market town and the county town of Essex, England, lying in the Chelmer valley at the confluence of the Cann, 30 mi. northeast of London. Chelmsford stands on a pre-Roman site and in medieval times was an important stopping-place on the London-Colchester route. It is the seat of the Bishopric of Chelmsford, and its cathedral, a graceful example of the Perpendicular style, lately enlarged and restored, was formerly the parish Church of St. Mary erected in 1442 on the site of an older edifice. The town has a handsome shire hall, a school founded by Edward VI, a museum and a notable corn and cattle exchange. It manufactures agricultural implements and metal goods. Pop. 1921, 20,769; 1931, 26,537.

**CHELMSFORD**, a town and village in Middlesex Co., northeastern Massachusetts. The village is situated on the Concord River about 5 mi. southwest of Lowell; it is served by the New Haven Railroad. It is an industrial community. The site was settled as early as 1655. Chelmsford and Lowell were separated in 1826. Pop. 1920, 5,682; 1930, 7,022.

**CHELSEA**, a city in Suffolk Co., eastern Massachusetts, situated between the Mystic and Chelsea rivers and connected by a bridge over the Mystic to Charlestown and Boston. It is served by the Boston and Maine and Boston and Albany railroads. Chelsea is primarily an industrial city manufacturing leather, shoes, paper, radios, clocks, rubber goods, roofing and furniture. Its manufactured products in 1929 were valued at \$27,638,009. The retail business

amounted to \$16,588,165. Waste material is extensively salvaged here. The Massachusetts Soldiers' Home is in Chelsea and the United States Government maintains marine hospitals. The main part of the city was destroyed by a fire in 1908 but has since been rebuilt. Pop. 1920, 43,184; 1930, 45,816.

**CHELTENHAM**, a municipal borough and watering-place of Gloucestershire, England, lying in the valley of the Chelt, sheltered on the east by the Cotswold hills, 109 mi. northwest of London. An early settlement, it flourished in Norman and medieval times. In 1716 mineral wells were discovered, and a pump room later erected, and upon the fancy of George III in 1788, Cheltenham suddenly became fashionable. The town is entirely modern in appearance and is a place of retirement for British colonials. It is particularly noted for many excellent schools. Among its attractions are a fine promenade, a winter garden and well-planned walks and parks. Pop. 1921, 48,430; 1931, 49,385.

**CHEMEHUEVI**, a Shoshonean-speaking tribe living on the east bank of the Colorado River in Colorado, Yuma and Mohave counties, Ariz., and over the State border in California. The Chemehuevi are closely allied to the Paiute. They were a nomadic people, living largely on the products of their desert environment, and since white contact hunting small mammals and, to some small extent, raising cotton, wheat, corn and some vegetables. They were fair basket-makers and, like other Colorado River tribes, used the balsa for river travel. The few hundred now surviving live on the Colorado River Reservation.

**CHEMICAL ACTION**, any process which results in the transformation of existing substances into other and different substances. *See* REACTION, CHEMICAL.

**CHEMICAL ACTIVITY**, a term used in chemistry to indicate the actual amount of transformation taking place in a mixture of substances as distinguished from the amount expected to take place from a calculation of the concentrations of the reagents present. In a sense therefore, it is a measure of the reaction-efficiency of the substances upon each other. The reason that this efficiency may be lower than that theoretically possible is that in concentrated solutions, or in compressed vapors, the molecular configuration of a substance appears to interfere with its ability to take part in reactions; while furthermore, especially in SOLUTIONS, the presence of ions (*see* IONIC THEORY) which are themselves foreign to the reaction, may seriously hamper, or even inhibit, the completion of the reaction. From thermodynamical considerations (*see* THERMODYNAMICS, CHEMICAL) the activity in gas reactions may be expressed by comparing an actual mixture of gases with a mixture of "ideal" gases—that is, gases which follow rigorously BOYLE'S LAW. In practice, chemical activity is generally represented by the so-called "activity coefficient," which is the factor to be applied to the actual concentrations of the reagents, gaseous or liquid, in order to convert them into such quantities as will fit the observed con-

ditions. The fact that such an activity coefficient is not the same universally for a given substance seems to indicate that a substance, as such, does not take a direct part in many reactions, but does so usually through intermediate reaction compounds, which are, naturally, characteristic of each reaction, rather than for each substance participating in it.

**CHEMICAL ANALYSIS**. *See under* CHEMISTRY: ANALYTICAL CHEMISTRY.

**CHEMICAL ENGINEERING** is distinguished from other branches of engineering in that the energy which it controls and utilizes is that chemical energy which is present in all materials and which is absorbed or released in chemical reactions. It controls industrial chemical reactions by means of the energy environment and is therefore an application of physical chemistry. The processes involved, such as crushing and grinding, mechanical separation, crystallization, filtration, drying, humidification, heating and cooling, evaporation, distillation, condensation and combustion, are operations which are common to all chemical industries and to many others. The function of the engineer is to analyze them in terms of the underlying physical chemistry and to control them by proper engineering equipment. This includes the choice of the proper materials of construction with a view to the chemical nature of the materials to be handled, the design of special apparatus suitable to the conditions, in material and energy, of the chemical reactions involved, and the control and operation of the processes and equipment. For this reason, such subjects as the strength of materials, the flow of fluids, the physical properties of gases, the flow of heat, the characteristics of fuels, the generation of power in furnaces, boilers and electrical generators, corrosion and lubrication, are integral portions of chemical engineering. The development of a special technique in all these subjects has made chemical engineering a vital factor in modern life and has made possible the phenomenal advance of industrial chemistry in recent years. *See also* CHEMISTRY, INDUSTRIAL. G. L. W.

**CHEMICAL EQUATIONS**, the mathematical representation of the process taking place whenever chemical actions occur. (*See* REACTION, CHEMICAL.) In the notation in general use in chemistry, the atoms of the different elements are each represented by symbols (such as H for hydrogen, O for Oxygen, C for carbon, Fe for iron, Cl for chlorine), and the composition of the molecule of each substance indicated by its chemical formula, that is, by the combination of the various letters representing the constituent elements, each symbol being accompanied by a suffix which specifies the number of atoms of this element present. Thus the formula  $H_2O$  indicates that a molecule of water consists of two atoms of hydrogen united to one atom of oxygen; the formula  $Na_2CO_3$  that a molecule of sodium carbonate or common soda is made up of two atoms of sodium, one of carbon, and three of oxygen.

The process of making hydrochloric acid from common salt and sulphuric acid may then be de-

scribed by the chemical equation:  $2\text{NaCl} + \text{H}_2\text{SO}_4 = \text{Na}_2\text{SO}_4 + 2\text{HCl}$ , indicating that two molecules of sodium chloride react with one molecule of sulphuric acid to form one molecule of sodium sulphate and two molecules of hydrochloric acid. The burning of magnesium ribbon in air, when the metal unites with oxygen to form magnesium oxide, is written as  $2\text{Mg} + \text{O}_2 = 2\text{MgO}$ , indicating that two atoms of magnesium react with one molecule of oxygen (which consists of two atoms of oxygen) in forming the desired compound.

The most important aspect of an equation is that, in connection with the known atomic weights of the various elements, it tells us, not only how many molecules react, but also how much in weight is required of each substance participating in the reaction and thus indicates the **STOICHIOMETRY** of chemical reactions.

W. J. L.

**CHEMICAL EQUILIBRIUM**, the state said to have been reached in a mixture of chemical substances between which reactions take place when the amount of each substance present no longer changes with time. It does not imply that all chemical reaction has come to a standstill, but merely that the amount of each substance being formed by the reaction taking place in one direction is equal to that being destroyed by the reverse process.

The fundamental law of all chemical action is the so-called law of mass action, which states that all reactions are due to collisions between molecules and hence that the speed of any reaction is proportional to the continued product of the number of molecules per unit volume of each of the participants. Thus, in the formation of ethyl acetate and water from ethyl alcohol and acetic acid, the speed of the reaction is proportional to the product of the concentration of alcohol, and acid. But, since the reaction is reversible, the speed of dissociation of ethyl acetate is proportional to the product of the amounts of ester and water. If such a reaction be schematically represented by  $A + B = C + D$ , the speeds of reaction in both directions are, respectively  $v = k \cdot A \cdot B$  and  $v' = k' \cdot C \cdot D$ , where  $k$  and  $k'$  are reaction constants which are, generally speaking, unequal. Equilibrium is reached when  $v = v'$  or when  $\frac{k}{k'} = \frac{C \cdot D}{A \cdot B} = K$ ,

where  $K$  designates the *equilibrium constant* which is dependent on the concentrations of the various reagents, and dependent only upon  $k$  and  $k'$ .

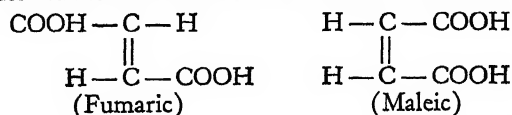
Since the speed of nearly all chemical reactions is very sensitive to temperature, the constants  $k$  and  $k'$  are likewise subject to change with the temperature, each in a different way, and thus at a higher temperature the time consumed in reaching equilibrium is generally much shortened, while, furthermore, the conditions of equilibrium are greatly altered. Where the reaction concerns simple dissociation, as of lime into calcium oxide and carbon dioxide, or of ammonium chloride into ammonia and hydrochloric acid, an increase in temperature invariably means a higher degree of dissociation, until, at very high tem-

perature, dissociation becomes complete. The equilibrium constant, though indicating that a certain condition has been reached, does not specify the relative amounts of dissociated and combined substances; these are determined by the relative concentrations or, in gas reactions, by the pressure. If, in the case of the dissociation of ammonium chloride, an excess of ammonia vapor is introduced, its consequently greater concentration will result in more ammonium chloride being formed than before, yet the equilibrium constant remains unaltered, and indicates that the relation between the speeds of reaction in both directions is the same as before.

The theory of chemical equilibrium is of the greatest importance in considering the electrolytic dissociation of substances dissolved in water, in which case the concentration of the various ions must be such as to satisfy the equilibrium conditions for the ionization of water into H and OH ions. See also **IONIC THEORY**.

W. J. L.

**CHEMICAL FORMULAE OR FORMULAS**, graphic presentation of chemical compounds by means of the symbols of their component elements. Chemical formulae are sometimes popularly characterized as the chemist's shorthand. Each element entering into the compound represented by the formula is designated by its "symbol" or abbreviation, accompanied by a subscript to indicate the atomic proportions in which it occurs. The subscript 1 is always omitted. Ordinarily the formula reveals something of the constitution as well as of the composition of the substance represented. Thus it is customary to write ions or radicals as units, repeating atomic symbols if necessary. For example, ethanol, or grain alcohol is customarily written  $\text{C}_2\text{H}_5\text{OH}$ , indicating that it consists of an ethyl radical,  $\text{C}_2\text{H}_5$ , joined to a hydroxyl radical, OH. Dimethyl ether which has the same *empirical* formula,  $\text{C}_2\text{H}_6\text{O}$ , as ethyl alcohol is customarily written:  $\text{CH}_3\text{OCH}_3$  or  $(\text{CH}_3)_2\text{O}$ . Empirical formulae are frequently employed for convenience in indexing or tabulating, or when the exact constitution of the substance represented is unknown. *Structural* formulae are employed when it is desirable to represent the structure of a compound in some detail. For instance, fumaric and maleic acids have the same empirical formulae,  $\text{C}_4\text{H}_4\text{O}_4$ , and the same ordinary formulae  $(\text{COOH})\text{CH}:\text{CH}(\text{COOH})$ , but they are geometrical isomers (see **ISOMERISM**) and their structural formulae are written as follows:



O. R.

**CHEMICAL LABORATORY APPARATUS**, that group of testing tools which the chemist uses to extend the range of his senses and tell him more accurately the degree by which one substance varies from another in composition or properties. While glass, porcelain and platinum were the materials used in the past for manufacturing such apparatus, the

newer acid and alkali-resisting alloys and modern manufacturing methods have increased the number of materials used and simplified the design. At present there are about five thousand different types of chemical apparatus. Many industries have standardized on methods of testing and the apparatus to be employed. The American Society for Testing Materials, the American Chemical Society and the Scientific Apparatus Manufacturers Association cooperate along this line. For descriptions of chemical laboratory apparatus the reader is referred to the catalogues of the manufacturers of chemical apparatus. A. Sc.

**BIBLIOGRAPHY.**—*Standard Methods for 1930*, American Society for Testing Materials; Arthur Schroder, "Works Control and Laboratory Equipment," *Industrial and Engineering Chemistry*, Vol. 21, 381, May, 1929.

**CHEMICAL PLANT EQUIPMENT.** When a chemical process is to be carried out on the industrial scale, the apparatus is profoundly different from that of the laboratory. The beaker becomes a tank. The flask becomes an evaporator (if solutions are to be concentrated) or a distilling column (if miscible liquids are to be separated). The funnel and filter paper are replaced by complicated mechanical filters, the mortar and pestle become crushing and grinding machinery, and the Bunsen burner is replaced by a steam coil. The percolator becomes an extraction battery; and in a similar way every operation requires special machinery. In addition, both liquids and solids must be conveyed—a problem that does not arise in the chemical laboratory.

Chemical plant equipment is oftenest made of iron or steel. But corrosive chemicals must be handled in apparatus made of special materials. Hence, the chemical engineer often uses plant equipment made of stoneware, glass, enameled metal, lead, copper, or special alloys. All these latter are expensive, and have serious drawbacks. The chrome-nickel steels (often called "stainless steels") seem to offer the greatest possibilities for the future, since they combine satisfactory mechanical properties with great resistance to many corrosion agents. W. L. B.

**BIBLIOGRAPHY.**—Badger and McCabe, *Elements of Chemical Engineering*, McGraw-Hill Book Co., 1931.

**CHEMICAL PRECIPITATION**, a sewage treatment method which hastens the process of settling and secures more perfect results where the suspended matter is in the finer COLLOIDAL STATE. The sewage in the *Settling Tank* is dosed with chemicals, such as alum and lime, which produce a flocculent precipitate to which the finer particles of the sewage adhere and with which they are settled out. This treatment is expensive. Its use is now largely confined to sewages containing trade, laundry or creamery wastes.

**CHEMICAL SOCIETIES.** Chemists have an international organization known as the International Union of Chemistry, but its activities are limited to committee work on a few problems of theoretical and international aspect such as nomenclature.

In each of the countries of advanced industrial development there exist one or more active chemical societies, usually one devoted to chemistry in general

or one for theoretical chemistry and one for applied chemistry, together with several smaller organizations devoted to specific branches of chemistry as electrochemistry, biochemistry, leather chemistry and the like.

The chief function of most of these organizations is the publication of the results of research. Each one publishes one or more journals, many of which contain several thousand pages each year. The largest of these chemical societies and their publications are the following:

**United States.** The American Chemical Society, Washington, D.C. Publications: Chemical Abstracts; Chemical Reviews; Industrial and Engineering Chemistry; Journal; Journal of Chemical Education; Journal of Physical Chemistry.

**Great Britain.** Chemical Society, London. Publications: British Chemical Abstracts (with Society of Chemical Industry); Journal.

Society of Chemical Industry, London. Publications: British Chemical Abstracts (with the Chemical Society); Journal.

**France.** Société chimique de France, Paris. Publication: Bulletin.

Société de chimie industrielle, Paris. Publications: Bulletin; Chimie & Industrie.

**Germany.** Deutsche chemische Gesellschaft, Berlin. Publications: Berichte; Chemisches Zentralblatt.

Deutschen Bunsen Gesellschaft, Berlin. Publication: Zeitschrift für Elektrochemie.

Verein deutscher Chemiker, Berlin. Publication: Zeitschrift für angewandte Chemie.

In 1926 the American Chemical Society celebrated the reaching of the half-century mark in its existence. A special number of the Journal of the American Chemical Society, called the Golden Jubilee Number, tells the story of this active and useful organization, one of the largest scientific societies in the world.

Human progress is made by cooperation and in this scientific and industrial age the great factor for progress is research. Cooperation in research is effected chiefly by means of the literature, published results of investigations, especially in scientific periodicals. The scientific societies make this means of cooperation possible by their extensive publication programs. Science knows no national boundaries. The publications of the scientific societies go to all parts of the civilized world and contribute much to the betterment of mankind's estate. The chemical societies, with their extensive abstracting and indexing systems provided to make the literature of chemistry readily available, have long been leaders in this important work. E. J. C.

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**CHEMICAL WARFARE.** The first successful use of chemicals in combat on a scale of sufficient magnitude to have an influence on the outcome of war took place during the World War, in Apr. 1915, on the Western Front at Ypres. This attack was so completely successful that, had the German command



realized the extent of the breach created in the Allied line, it is quite possible that a complete break through to the coast might have been effected. While this attack may be considered the first instance of successful employment of this agency in warfare, it does not represent the earliest use or consideration of this means of attack. As early as 431-404 B.C., the Athenians and Spartans employed suffocating gases in the siege of Plataea and Belium. The materials used were pitch and sulphur. These two substances were used by different armies down through the ages for this purpose, usually on too small a scale to be successful. The English Admiral, Lord Dundonald, contemplated the use of sulphur fumes in his plan for the reduction of Sebastopol; however, the plan was not approved. The Civil War was not without the threat of chemical warfare. In the siege of Charleston, shells containing asphyxiants and suffocants were fired into the city, resulting in a bitter exchange of messages that caused President Lincoln to forbid the further use of this means of warfare. Practically all nations maintain a chemical arm in their military forces and modern opinion is to the effect that this is one of the most efficient ways of overcoming enemy resistance.

Chemical agents (gases) are used to produce casualties in various forms. The death and destruction of enemy forces is not always necessary in order to impose compliance on opposing forces. Chemical agents offer the means of producing non-effectives by temporarily rendering forces *hors de combat* as well as by the actual death of combatants. Chemical agents, therefore, are classified according to their action. Lacrimatory agents are those that temporarily blind by producing a stinging pain in the eyes accompanied by such a profuse lacrimation as to render the individual noneffective. Sensory irritants are agents that cause sneezing, vomiting and other disturbances that render the sufferer noneffective. Lung irritants are agents that react with the respiratory mucous membrane to produce casualties. The vesicants are agents that, on contact with the skin, produce blisters or burns that are often disabling. These same agents in the form of vapors not only have this vesicant property, but, when inhaled, have proved very effective as lung irritant gases. Certain agents that produce rapid death by respiratory paralysis or other central nervous system action, such as results from inhaling hydrocyanic acid gas or CARBON MONOXIDE, are designated as lethal gases. Much was expected of these so-called lethal gases in the World War but the results obtained were negligible. Chemicals are also classified for tactical purposes into persistent and non-persistent, depending upon the length of time that the terrain remains contaminated when chemical agents are employed.

**Non-Persistent Agents.** CHLORINE gas was the first chemical employed by the German Army. This gas was dispersed from cylinders brought close to the front and released when the wind and climatic conditions were favorable to float out and over the enemy lines in the form of a gas cloud. This form of attack

is too dependent on uncontrollable factors to be of general value. Later attacks with this agent were by means of projectors, as Liven's projectors. This form of attack allows for better concerted action, as the use of chemicals can be timed and is not absolutely dependent on wind direction. Pure chlorine was used in cylinders and projectors for only a short time, effective masking to combat this agent giving rise to the use of PHOSGENE,  $\text{COCl}_2$ , also known as carbonyl chloride.

Phosgene is similar in all its actions to chlorine, but relatively much more toxic and in every respect a more effective agent to handle in the field. Its action is entirely due to the chlorine that is liberated when the gas contacts the moisture that is present in the respiratory mucous membrane. Diphosgene is also dependent on the available chlorine for its action, and was used by the Germans as a lung irritant. Chlorine, phosgene and diphosgene are all non-persistent lung irritants.

**Lacrimators.** Chemical agents that produce conjunctival irritation with the resulting blinding action are very valuable casualty producers. Most of the effective lacrimators are organic compounds carrying one of the HALOGENS usually chlorine or BROMINE. Benzyl bromide, brombenzylcyanide and chloracetophenone are the most effective lacrimatory agents available. Chlorpicrin is a lacrimatory agent that combines other properties. It produces vomiting, causing unmasking, and, in higher concentrations, is quite an effective lung irritant.

**Persistent Gases.** MUSTARD GAS, or Yperite, was, and remains, the most effective persistent gas employed during the World War. Mustard gas in the liquid or vapor form has a powerful vesicant action. In the vapor form it produces respiratory symptoms. It is sometimes referred to as a lacrimator. This use of the term is incorrect, as mustard only produces lacrimation after sufficient interval follows exposure to allow conjunctivitis to develop. Mustard was first used by the Germans against the English forces in the Ypres salient near the point where their initial gas effort was made with chlorine. For this reason the term Yperite is often used in referring to this agent.

H. L. G.

**CHEMIST**, one who studies or controls the processes whereby various substances are transformed into other substances with differing properties. To this end the chemist must not only investigate the properties of known substances and the energy changes involved in the reaction of these substances with one another, but he must also attempt to produce new substances and must search for the fundamental concepts of matter and energy which will best explain the phenomena he observes. The chemist deals with matter, on the one hand, in terms of invisible electrons, and on the other, in terms of tons of material undergoing industrial chemical processes. The domain of chemistry has become so broad that chemists frequently are classified under such headings as analytical, physical, colloid, inorganic, organic, biological,

physiological, pharmaceutical, or food chemists. The chemist is significant as the agent of transformation not only in the material but also in the social sense, since in one or another of his specialized rôles he has been vitally active in nearly every development of industrial civilization and is constantly tending to change the conditions of human life by the synthesis of new substances, or the discovery of new applications for substances already known. E. P. P.

**CHEMISTRY**, the science which treats of the composition of matter, and the changes which occur in the composition of a substance. These changes may take place either spontaneously or by the application of heat, electricity, or like agents, and by the interaction of two or more substances upon each other. The fundamental assumption of chemistry holds that all *molecules* of matter, that is to say, the smallest possible particles which are distinctive for each particular substance, are composed either of one or more still smaller particles, called *atoms* (see **ATOMIC THEORY**) of pure substances (called **ELEMENTS**), or of combinations of two or more of these elements. Of these elements 91 are now known (one still to be discovered). It is with the collective behavior and the interaction of these atoms and the more complex molecules built up from them that chemistry is primarily concerned.

In recent years it has been found that these atoms are themselves divisible, and are made up of combinations of from one to 92 pairs of electrically charged particles, designated as **PROTONS** and **ELECTRONS** (see also **ELECTRONICS**). The study of these protons and electrons and the structure of the atom is a field covered jointly by physics and chemistry.

The name chemistry is derived, it is believed, from the ancient Egyptian word *khem*, meaning black, and used to indicate the characteristic blackness of the soil in Egypt; as it appears reasonably certain that chemistry had its origin in Egypt, and thus became known as the Egyptian or Black Art. For its subsequent development throughout the ages, see **section HISTORY OF CHEMISTRY** (below).

In its present state, the science is usually divided into three main branches, viz., **INORGANIC**, **ORGANIC** and **PHYSICAL CHEMISTRY**. (See below.) The first of these, also called mineral chemistry, is concerned with the study of all the elements and their compounds, except carbon, while organic chemistry has as its field the vast number of carbon-compounds, and thus also includes all organic and living matter. Physical chemistry, another borderland of physics and chemistry, treats more of the physical characteristics of chemical elements and compounds, gases, liquids, solids, mixtures, and solutions, while its subdivisions **THERMOCHEMISTRY** and **ELECTROCHEMISTRY** comprise those phenomena in which heat or electricity are involved.

In both inorganic and organic chemistry, the subdivisions analytical and **SYNTHETIC CHEMISTRY** are distinguished, the former dealing with the separation, determination, and estimation of the elements oc-

curing in mixtures and compounds (see below, **ANALYTICAL CHEMISTRY**), while the latter deals with the reverse process of building up more complex substances from simpler ones.

Applications of chemistry have pervaded all of industry and engineering and their ramifications, and are known collectively as **INDUSTRIAL CHEMISTRY** and **CHEMICAL ENGINEERING**; the manufacture, study and use of drugs is contained in **PHARMACEUTICAL CHEMISTRY**; the applications to physiology and the study of all living matter in **BIOCHEMISTRY**. W. J. L.

### HISTORY OF CHEMISTRY

Although chemistry as an exact science is scarcely more than one hundred years old, its history stretches back into very remote antiquity, for the recognition of chemical phenomena and the accumulation of chemical facts began at an early stage in the development of human intelligence. All the great ancient civilizations have left evidences of familiarity with many important raw materials and methods of manufacture. Trade and commerce were stimulated by the traffic in exotic substances, such as dyes and aromatic oils.

**The Greek Philosophers** speculated about the constitution of matter and evolved the idea of primordial principles from which all things were derived. They also enunciated the theory that all matter was composed of minute particles or "atoms," the fundamental doctrine of modern chemistry.

According to **ARISTOTLE**, however, all matter consisted of the same elemental principles—air, fire, earth, water, and a mysterious fifth or "quintessence," the *materia prima*, or fundamental principle of all matter. By changes of the four elements acting upon this fundamental matter, he believed substances could be transmuted from one kind of matter to another. It was, therefore, natural for the medieval workers to attempt for several centuries the transmutation of some forms of matter into others, particularly that of base metals into noble gold. Later this same underlying principle was applied to the preservation and prolongation of life.

**The Arabian Scholars.** From the 4th to the 13th centuries, Greek philosophy was preserved and propagated by Eastern scholars. The Arabs in particular developed the ancient speculations regarding the composition of matter, principally the Aristotelian idea of the mysterious "quintessence," or the one fundamental substance. Moreover, the Arabs engaged in much experimental work which they recorded and which was transmitted to Europe in the Middle Ages.

**Alchemists.** The principal tenet of the alchemist's faith was that of transmutation. The necessary agent was called "Quintessence," "Elixir," "Grand Magisterium," and finally "*Philosopher's Stone*." There was much confusion as to the powers of this miraculous substance, but it was generally held capable of liberating the *materia prima* and transforming it into silver and gold.

The idea of transmutation was derived from the Greek hypothesis of one primordial principle, a *materia prima*, which was obtainable, by the proper means, from all substances. It is easily understood that the minds of men would be fired by the thought of a key to the transmutation of the base metals into gold. According to the alchemistic doctrines, this would be accomplished by removing from the *materia prima* the four Aristotelian elements, i.e., the qualities represented by them: air-warmth and wetness, fire-warmth and dryness, earth-cold and dryness, water-cold and wetness. The fundamental substance thus obtained would give silver and gold when treated with the Philosopher's Stone.

With time, other attributes became associated with the potent stone, whose description varied with each alchemist. During the 14th and 15th centuries, it was prescribed to preserve and prolong life, increasing the wisdom and virtue of its fortunate owner at the same time; in other words, it would ennoble lives as well as metals. As time went on, the Philosopher's Stone was endowed with medicinal virtues; it became the medicine for man and for metals. This led to a new era in the development of chemistry (see IATROCHEMISTRY). The importance of chemical preparations in medicine is stressed in the writings to Basil Valentine, a possibly mythical alchemist of the 15th century. Furthermore, these writings expound a system of *tria prima*, three fundamental elements, or rather indefinite combinations of properties named sulphur, mercury and salt. See ALCHEMY.

**Chemistry in the Middle Ages.** However, the work of the alchemists included, together with much mystical quackery colored by mercenary motives, some serious scientific work. *Albertus Magnus*, for instance, was one of the greatest philosophers and teachers of the Middle Ages. He believed that, although transmutation was impossible, metals were derived by blending qualities represented by the names "mercury" and "sulphur," an idea widely disseminated throughout alchemistic literature. Mercury and sulphur were associated with the primordial principle and with the Philosopher's Stone respectively, and were sometimes held to represent the human spirit and soul.

**Roger Bacon.** The dominating position of the period, however, is held by Roger Bacon (1214-1292), who discarded the preconceived ideas which the scholastic thinkers had inherited from Aristotle and guarded jealously, in favor of the so-called *scientific method*, which coördinates experimental fact and observation. Bacon's writings had little influence upon his contemporaries and immediate followers, who were busying themselves with the search for fabulous elixirs. Nobles and kings supported these investigations and even participated in them, though some alchemists paid with their lives for their failure to obtain inexhaustible riches.

By the 17th century, there had been built up, along with much fictitious charlatanry, a body of facts which were employed for the further investigation of nat-

ural phenomena by the scientific method, using sensory observation, and not rationalization, to accumulate data. The atmosphere, water, many other common materials were examined. The ancient "elements," fire among them, were discarded in favor of the elements of *Robert Boyle*, which he defined as ultimate, undecomposable substances. This is essentially the modern conception, and it required a new explanation for the phenomena of burning, or combustion, which was supplied by the *phlogiston theory*. This held sway until the classic work of *Lavoisier* demonstrated irrefutably that combustion was the process of combining oxygen from the air with a consequent gain in weight and not the loss of something intangible.

**Modern Chemistry.** The ATOMIC THEORY of *Dalton* clearly set forth the concept of small, discrete particles as the ultimate units of matter, the atoms of each element being different. Quantitative experiments furnished remarkable confirmation of this fundamental doctrine of modern science.

Chemistry made phenomenally rapid progress from the end of the 18th century. Thousands of familiar substances were analysed and reproduced by synthesis. Organic chemistry—the chemistry of carbon compounds, since animals and plants are fundamentally mixtures of carbon compounds,—grew by leaps and bounds. From a knowledge of the composition of naturally occurring substances, new compounds possessing valuable new properties were made in laboratories; the story of organic chemistry is truly a romance. See below: ORGANIC CHEMISTRY; INORGANIC CHEMISTRY.

Theory had to keep pace of this veritable flood in order to induce some orderly classification. Many generalizations, or natural laws, were introduced and confirmed. The modern trend is toward the correlation of properties of substances with their chemical constitution, the realm of physical chemistry. The brilliant discovery of RADIOACTIVITY and subsequent studies of atomic structure have furnished a new insight into the constitution of matter, the great problem today as in the days of the Greeks.

Once again we are postulating a "materia prima" (protons and electrons) and we find transmutation of one element into another possible and probable. The story of chemistry is still that of a quest into the ultimate nature of things. P. M. A.

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#### ANALYTICAL CHEMISTRY

One of the branches of fundamental importance in chemistry whose task it is to determine the constituents of chemical compounds and mixtures, and as such it is the opposite of synthetic chemistry (see SYNTHESIS, CHEMICAL). It may be broadly divided into qualitative and quantitative analysis, where in the former only the presence or absence of each element or radical is investigated, while in the latter the exact proportion in which these elements are combined or

mixed is required. The methods of analytic chemistry differ greatly according as they have to be applied to inorganic or organic substances: in the latter case a qualitative analysis is of only preliminary value, and even a quantitative analysis is by itself rarely sufficient to identify the compound in question. Apart from the more general methods mentioned under CHEMICAL ANALYSIS, (see below), special aspects of the problem, or those requiring a special technique, have also been treated separately under ELECTROANALYSIS, GAS ANALYSIS and MICROANALYSIS.

Chemical analysis, as applied to inorganic compounds, is divided into two classes, *qualitative* and *quantitative* analysis.

**Qualitative analysis** is subdivided into *dry* and *wet* analysis. *Dry analysis*, though generally only of preliminary character, is of much value to the prospector and miner in the field, who cannot command the resources of a laboratory. The substance is either heated directly, and the gaseous products, if any, as well as the residue observed, or the residue treated on a piece of charcoal with a blowpipe: if lead, copper, or precious metals are present, these will emerge in the form of small globes of molten metals, while further fusing of the substance with borax may, through the characteristic colors produced, give a clue as to the metallic constituents. The coloring imparted to a flame, or the more refined examination of this with a spectroscope may reveal directly the presence of a number of metals.

In *wet analysis* the substance is first dissolved in water or acids, and then treated with certain characteristic reagents such as hydrochloric acid, hydrogen sulphide, or ammonium salts, by means of which the metals may be separated into groups, and subsequently identified individually. The acid radicals present are then found by similar means.

**Quantitative inorganic analysis** is divided into *gravimetric*, *volumetric* and *colorimetric* analysis. *Gravimetric analysis* follows, in general, the same methods as the qualitative analysis, and finally determines the amount of each element present by drying and weighing it as a precipitate (see PRECIPITATION). Special care has to be taken against errors creeping in through the very slight solubility, and consequent waste, of some of these.

In *volumetric analysis* use is made of titration with solutions of known strength, of certain reagents, and determinations made either by precipitation, or by use of a COLORIMETER. Silver, for example, may be determined by measuring the amount of standardized solution of sodium chloride necessary to precipitate all the silver from a solution; while the amount of acid or base may be determined by titrating with a standard solution of alkali or acid, respectively, and the use of INDICATORS, to show when neutralization is completed.

**Organic analysis.** In organic analysis the qualitative methods constitute no more than a preliminary test for the presence of nitrogen, sulphur, phosphorus, or the halogens. Carbon and hydrogen are then quantitatively determined in the form of carbon dioxide

and water, by burning the substance in an excess of oxygen. The extraneous elements are each determined by special methods, and the amount of oxygen is then stated as the "difference."

### INORGANIC CHEMISTRY

Inorganic chemistry, the oldest division of chemistry, known also as mineral chemistry, deals with all the elements except carbon, and their compounds. The majority of these elements have properties resembling those of the metals, such as sodium, calcium, aluminium, iron, and platinum, but some, mainly the lighter ones, such as nitrogen, oxygen, phosphorus, sulphur, and chlorine, differ radically from the former, and are classed as non-metals, or metalloids. Among the more important inorganic compounds are: the hydrides, containing hydrogen and but one other element, and comprising water, ammonia, sulphuretted hydrogen, and the halogen acids, such as hydrochloric acid; halides, containing one of the halogens, fluorine, chlorine, bromine or iodine, and one other element; sulphides, containing sulphur and one other element; oxides, constituting compounds with oxygen, and distinguished into two classes—those of the metals, which usually give rise to bases (such as caustic potash), and those of the non-metals, which usually give rise to acids (as sulphuric acid). Combinations of acids and bases generally produce salts, while these may further unite into compound salts or form hydrates by taking up water.

### ORGANIC CHEMISTRY

Organic chemistry is essentially the chemistry of carbon compounds, including those complex substances which characterize living organisms, though, on the other hand, the simpler combinations of carbon, such as the oxides, carbonic acid, and its derivatives, the sulphides, etc., are generally treated under inorganic chemistry. Owing to some peculiarity in the constitution of the carbon atom, not yet fully understood, but undoubtedly related to its tetravalence (see VALENCE), carbon seems to possess almost limitless possibilities of combining with itself, as well as a great facility of and variety in its combinations with other elements, notably hydrogen, oxygen and nitrogen. For this same reason organic substances may be of great complexity and in describing them chemically it is necessary not only to note the relative number of atoms of each element in the molecule, but its structure as well, that is, the manner in which these atoms are combined (see ISOMERISM, and STEREOCHEMISTRY).

The broad division of organic substances is into open-chain, or ALIPHATIC COMPOUNDS, and cyclic or closed-chain compounds. The former may be considered as derived from the HYDROCARBONS of the PARAFFIN and OLEFINE series; addition of oxygen gives rise to ALCOHOLS, ETHERS, ALDEHYDES and KETONES (organic acids) and CARBOHYDRATES, including sugars. The cyclic compounds are further subdivided into HOMOCYCLIC and HETEROCYCLIC, the former comprising the vast number of BENZENE derivatives, as well as

those of the cycloparaffins, in all of which the cyclic base contains only carbon atoms, while the latter have other elements, such as nitrogen, as an integral part of the ring. The almost infinite variety of compounds generated along these lines may be still further extended and complicated by the replacement of hydrogen atoms by halogens, sulphur, nitrogen and their derivatives.

#### PHYSICAL CHEMISTRY

Physical chemistry is that subdivision of chemistry which treats of the physical properties and behavior of substances insofar as these are dependent upon their chemical constitution. Thus, the general relations between pressure, temperature and volume of gases are studied with a view to the changes taking place when chemical reactions occur, such as dissociation or associations (*see* ASSOCIATION, CHEMICAL); likewise the conditions governing the liquefaction of gases, and the properties of the critical point, the behavior of mixtures of gases, liquids and solids and the laws relating to it, such as the PHASE RULE. The boiling and freezing points of mixtures of liquids and of solutions; the optical behavior of, and the osmotic pressure exerted by, the molecules of a dissolved substance; the electrolytic (*see* ELECTROLYSIS) dissociation taking place in solutions, and its dependence upon the nature of the solvent as well as the electrical conductivity involved and the general properties of colloidal solutions (*see* COLLOIDS)—all fall under physical chemistry; likewise the study of the speed of chemical action, of the heat involved in the formation and decomposition of compounds, the problems of reversible and irreversible reactions and of chemical statics and dynamics in general including that of chemical equilibrium.

#### APPLIED CHEMISTRY

Applied chemistry is that branch covering all applications of chemistry made in other sciences or the arts and crafts, and thus includes such important branches as INDUSTRIAL CHEMISTRY, pharmaceutical chemistry, and BIOCHEMISTRY, etc. Its field consists essentially of the study of problems and processes of technical importance, and the preparation of compounds on a large scale. The principal difference between it and pure chemistry, therefore, lies in the methods which, in applied chemistry, must be such as to ensure commercial feasibility. Thus, the cost of apparatus or plant needed should not be prohibitive, and the procedure must be simple enough to allow rigid control over the reaction even when performed on a large scale. For example, "fixation" of nitrogen (*see under* NITROGEN) from the air into nitrates for fertilizer, though long known, attained practical importance only when the procedure was so modified as to give a yield competitive commercially with the natural products from the Chilean deposits. In the application of chemistry to food analysis and the general problem of public health, simplicity of procedure is the first essential. *See also* CHEMICAL PLANT EQUIPMENT.

W. J. L.

**CHEMNITZ**, the third largest city in Saxony, situated about 43 mi. southeast of Leipzig. Since the beginning of the 19th century it has forged ahead and become one of the foremost spinning and weaving centers. It is the world's capital for the stocking, glove and tricot industries and for the construction of textile machines. There are numerous vocational schools. The King Albert Museum contains various collections. The principal buildings are of recent date, though there is a church of the 15th century, restored in 1913, and a castle which was formerly a Benedictine abbey, now used as a place of amusement. The castle church was rebuilt in late-Gothic style in the 15th century. Pop. 1925, 331,655.

**CHEMOTAXY**, the movement of living organisms toward or away from a substance due to chemical stimulation. Fern sperms are attracted to move toward the mouth of the archegonium containing the egg by malic acid which is secreted by the surrounding tissue. It appears to aid the sperm to find the egg which is to be fertilized in order to effect reproduction. Sperms of different species vary as to the kind of chemicals by which they are attracted. Moss sperms are attracted to the archegonium by sugar whereas this has no effect on many other species and may repel some. Isoetes sperms are attracted by both fumaric and malic acids and sperms of bryophytes are attracted by sugar and protein solutions. Many different chemicals in solution are known to effect movement of swimming sperms. The movement may be toward or away from toxic chemicals and though a good purpose is served the phenomenon should not be looked upon as purposeful. The response is due to some fundamental property of the protoplasm and the result happens to be beneficial for the organism.

P. W. Z.

**CHEMULPO**, a town and port on the west coast of Korea, 25 mi. west of Seoul. It is one of the three treaty ports opened in 1883 to foreign commerce; and now is the terminus of the railroad with an important trade, exporting rice, beans and hides, and importing petroleum, metals and cotton goods. Pop. 1928, 57,449, including 11,206 Japanese.

**CHÉNIER, ANDRÉ DE** (1762-94), French poet, was born at Constantinople, Oct. 30, 1762. With his French father and Greek mother he went in 1765 to Paris, where he early began his poetic work. After some time in Italy and in London, he took up political writing in Paris in 1790. On Mar. 7, 1794, Chénier was arrested by the Revolutionists, imprisoned for 141 days, and sentenced to death. His finest poems were written in prison, including the *Jeune Captive*, but little of it was collected or published until many years after his death. Chénier's works include *La jeune Tarentine*, *Jeu de paume* and *Iambes* and he is now recognized as the greatest French lyricist of his century. The poet died on the guillotine in Paris, July 25, 1794.

**CHENOPODIUM**, in botany, a large genus of plants of the goosefoot family. The group comprises about 60 species, mostly annual and perennial herbs



of the temperate regions, many of which, as the lamb's-quarters (*C. album*) are widespread as weeds. They usually bear white, mealy, sometimes glandular, strong-smelling foliage, inconspicuous green flowers and multitudinous small seeds. The quinoa (*C. Quinoa*) is cultivated in Peru and Chile for food; the strawberry blite (*C. capitatum*) and good-King-Henry (*C. Bonus-Henricus*) are sparingly grown as potherbs; the feather-geranium (*C. Botrys*) and the purple goosefoot (*C. purpurascens*) are planted as garden ornamentals, and the wormseed (*C. anthelminticum*) yields an essential oil used as a vermifuge.

**CHEOPS** or **KHUFU**, an early king of Egypt who lived about the middle of the fourth millennium B.C. He is famous for the enormous pyramid he forced his subjects to build at GIZA, near Cairo.

**CHEPSTOW**, a river port and market town in the county of Monmouth, southwestern England. It is situated on the River Wye, 2 mi. from the place where it joins the Severn, on a slight hill between lofty cliffs; Newport lies 15 mi. to the southwest. The chief structures are the church, a worthy specimen of Norman architecture, and a castle founded in the 11th century, the ruins of which top a high promontory overhanging the Wye. Glass was the local manufacture in early times. The streets are paved and illuminated satisfactorily. Coastal trade is carried on. Pop. 1931, 4,303.

**CHERBOURG**, a French fortified city and naval station on the English Channel, in the department of Manche, situated at the mouth of the Divette River. It is the principal port of call for transatlantic liners in France. The present commercial harbor was begun in 1831, later much enlarged, and in the years following 1923 subject to great further development, with the object of enabling the largest ocean liners to dock at the piers. The city has factories and maintains fishing fleets. The Church of La Trinité dates from the 15th century. Cherbourg was a base for British and American troops during the World War. In medieval times the city was held at various periods by the English. Pop. 1931, 37,461.

**CHERIMOYA**, a tree (*Annona Cherimola*) of the custard-apple family, native to tropical South America but grown in many warm countries, in some of which it has become naturalized. In a limited way it is grown in Florida, Louisiana and California. When mature it often reaches 30 ft. in height and has drooping branches. Its fragrant flowers are followed by roundish or heart-shaped highly perfumed fruits which vary from green to brown and from the size of an orange to that of a large cantaloupe, 15 lbs. or even larger. Beneath the thick, tough skin the snow-white subacid juicy flesh is arranged in petagonal or hexagonal form. Among tropical fruits perhaps none is so highly esteemed by Europeans and Americans to whom its subacid flavor is especially pleasing.

**CHERNIGOV**, a river port in north-central Ukrainian S.S.R., picturesquely situated on the right bank of the navigable Desna River, on the Boldina Mountain, the small Strijen River valleys dividing

the town into two sections. Flour and lumber-trading is well developed; there are also brick works, shoe factories and a radio station. The city was the capital of an independent state in 1024, a rival to Kiev. Noteworthy are the rampart, Ukraine's oldest architectural memorial, and the 11th century Cathedral of the Saviour. The State Museum is one of the richest in the Republic. Pop. 1926, 35,234.

**CHEROKEE**, an important tribe of the North American Indian Iroquoian linguistic stock. They lived formerly in the southern Alleghenies in southwestern Virginia, western North and South Carolina, northern Georgia, eastern Tennessee and northeastern Alabama, and claimed a territory as far as the Ohio River. Cherokee was classified into three dialects: Elati, Middle Cherokee and Atali, Mountain or Upper Cherokee. The Cherokee were undisturbed in their original habitat until 1838. The discovery of gold in Georgia shortly before this date led to their exile to Oklahoma. Several hundred escaped this forced removal and were allowed to remain in western North Carolina where they now live, numbering about 2,000. About 30,000 live in Oklahoma. Like the other southeastern tribes they were agriculturists and lived in villages. They had a clan organization and were potters and basket-makers. Their most important ceremony was the green corn dance.

**CHEROKEE**, a city in northwestern Iowa, the county seat of Cherokee Co. It is situated on the Little Sioux River, 180 mi. northwest of Des Moines. The Illinois Central Railroad serves the city. Grain and livestock are raised in the vicinity. Agricultural implements are the chief manufactures. The city is the seat of Cherokee Junior College for Girls. The original site, 1 mi. from the present city, was settled in 1856. Pop. 1920, 5,824; 1930, 6,443.

**CHEROKEE WAR**, 1759-60, a conflict between Indians and whites on the southern frontier. The Cherokee, then living in the southwestern valleys of the Appalachian chain, mustered about 2,800 warriors. After a series of border outrages, 1758-59, Gov. Lyttleton of South Carolina determined upon a war of extermination, and marched westward in Oct. 1759, with 1,500 men, taking with him about 25 Cherokee chieftains who had come to Charleston to discuss peace and had arbitrarily been seized. At Ft. Prince George, on the eastern slope of the mountains, Lyttleton demanded of the Cherokee the surrender of 24 certain Indians. Three were surrendered, ultimately to die in prison at Charleston; and a temporary pact signed which was later rejected by the great body of the Cherokee. Leaving the captive chieftains at the fort, Lyttleton returned to Charleston. The Cherokee in Jan. 1760 killed 14 men near Ft. Prince George, besieged the post, and killed the commander; the captive chieftains were slaughtered in retaliation. The Indians then ravaged the frontier. Col. Archibald Montgomery with a company of British regulars, sent at Lyttleton's request by Gen. Amherst, commander-in-chief of British troops in America, with a force augmented to 1,650 men by provincial

volunteers marched westward in May 1760, and burned several Indian villages. Near the site of Franklin, N.C., on June 27, the Cherokee attacked from ambush and forced Montgomery to retreat. In August the Indians forced the evacuation of Ft. Loudon and murdered most of the garrison. A second body sent by Amherst, 1,200 Highlanders under Col. James Grant, invaded the Cherokee country in May 1761, defeated the Indians, and burned about 15 villages. Peace was concluded at a council at Ashley Ferry, Sept. 15, 1761.

**CHERRY**, the name given to many species of fruit-bearing trees and shrubs, of the ROSE FAMILY. The wood of the American wild black cherry (*Prunus serotina*) is valued for cabinet-making and its bark for medicine. Two shrubby species, the eastern sand cherry (*P. pumila*) and the western sand cherry (*P. Besseyi*) have produced varieties of limited value in the prairie states where cultivated European cherries fail. The sand cherries and the pin or bird cherry (*P. pennsylvanica*) a shallow rooted tree on poor soils are sometimes planted for ornament. The choke cherry (*P. virginiana*), usually a bush but sometimes a small tree, is also ornamental and has produced large-fruited edible varieties. The California holly-leaf or evergreen cherry (*P. ilicifolia*) is a large highly ornamental evergreen bush or small tree with shiny leaves, white flowers and large black fruits. Two Japanese species (*P. serrulata* and *P. tomentosa*) are famous for the beauty and variety of their single and double pink, red and white blossoms and for the "cherry festival" annually held in Japan in their honor. Among the best known varieties in America are those presented to the United States by the Japanese government and planted at Washington, D.C.

The mahaleb cherry (*P. Mahaleb*) a European species makes a slender ornamental tree with small, fragrant, white flowers appearing a month later than those of the cultivated fruit-bearing cherries. Though their fruit is inedible, mahaleb seedlings have been used as stocks on which to graft cultivated varieties of cherries to be grown for fruit. However, the union of the mahaleb stock and scion has proved less satisfactory than that made on the so-called "mazzard" cherry stocks, which are seedlings of the sweet cherry (*P. avium*), also an Old World species.

This species (*P. avium*) is one of the two most important progenitors of cherries grown for their fruit. It forms a spreading robust tree sometimes 100 ft. tall and is the progenitor of all cultivated sweet cherries, of which there are two classes, the hearts, or soft-fleshed varieties and the bigarreaus or firm-fleshed kinds. It is also one of the parents of the duke varieties. The sour or pie cherry (*P. Cerasus*) is the other parent. The latter is the original parent of the sour varieties, which are grouped in two classes: the morellos, in which the juice is red, as the English Morello and Olivet, and the amarelles, with colorless juice, as the Montmorency and Early Richmond. According to Dr. U. P. Hedrick, the duke cherries, as the Reine Hortense and Late Duke, are unquestion-

ably hybrids between the sweet and sour cherries, for in many ways they are intermediate, especially in flavor, being subacid, neither sweet nor sour but a blend of both. For this reason the duke cherries are ideal home-garden dessert varieties.

#### CHERRY PRODUCTION, U.S.

5-Year Average, 1926-30

Division	Production (Tons)	% of Total
UNITED STATES .....	88,453	100.0
LEADING STATES:		
California .....	17,100	19.3
Michigan .....	16,400	18.5
New York .....	14,680	16.5
Oregon .....	11,820	13.3
Washington .....	9,480	10.7
Wisconsin .....	7,180	8.1

Cherries thrive best on deep, well-drained gravelly soils well-supplied with humus and moisture, but not wet. They are grown successfully from Newfoundland to Vancouver and southward in the mountains and highlands to the Carolinas and California but less in the dry regions of the West where they often fail to fruit or even to live. In the East the sour varieties are the leaders in commercial orchards. On the Pacific coast the bigarreaus are most extensively planted, the fruit shipping well to eastern markets.

M. G. K.

**CHERRY-LAUREL**, the name given to several widely planted, highly ornamental shrubs and small trees of the rose family, called also laurel, but not the true laurus. They bear handsome evergreen foliage, clusters of white flowers and small nauseous fruits. The common cherry-laurel (*Prunus Laurocerasus*), extensively cultivated in many forms, is a native of southeastern Europe. The wild cherry-laurel or mock-orange (*P. caroliniana*), native from South Carolina to Texas, and the Portugal cherry-laurel (*P. lusitanica*), native to southwestern Europe, are widely grown in the South.

**CHERRY ORCHARD, THE**, a melancholy "comedy" of Russian life by ANTON CHEKHOV, produced 1904. A noted example of Chekhov's "detheatricalization," this is the beautifully simple drama of an eccentric landed family who become, through their extravagance and noble incapacity for the practical affairs of life, so engulfed in debts that they must sell a cherry orchard, their most cherished property, to the son of a former serf. The action of the play is always of less importance than the emotional accompaniment to the action.

**CHERT.** See FLINT.

**CHERUBIM**, winged beings having human or animal faces, mentioned in the Old Testament as members of the celestial hierarchy, particularly as guardians of sacred places and as attendants upon Jahweh. They may have been conceived once, according to the testimony of ancient Babylonian inscriptions, as colossal winged bulls. Other Oriental religions refer to winged creatures similar to the Semitic cherubim. In Genesis 3:24 cherubim are first men-

tioned as guardians of Eden. They appear in Ezekiel 1 and 10 as living creatures attending upon the divine chariot, each cherub having four wings and the four faces of a man, an ox, a lion and an eagle. Exodus 25:18-22 and 37:6-9 prescribe that the mercy seat of the sacred ark within the tabernacle be covered with two gold cherubim. In art cherubim have often been represented as beautiful winged children or as the winged heads of children. See also SERAPHIM.

**CHERUBINI, MARIA LUIGI SALVATORE** (1760-1842), Italian music composer, was born at Florence, Sept. 14, 1760. In 1787 he settled in Paris, where he lived the greater part of his life, and his compositions reveal French influence. Schooled under Giuseppe Sarti, he developed great contrapuntal skill. His early compositions were ecclesiastical, but he turned from the church to the stage, producing nearly a score of operas. In 1789 he became an inspector in the Paris Conservatoire, in 1816 a member of the faculty, and its director in 1821. According to his own catalogue of his works, he composed 11 masses, 2 requiems, 38 motets, 17 cantatas, 6 string quartets, 6 pianoforte sonatas, 15 Italian and 14 French operas, besides less pretentious works. Haydn and Beethoven admired his opera *Faniska*, the latter regarding him as the greatest opera composer of the day. He died at Paris, Mar. 15, 1842.

**CHERVIL** (*Anthriscus cerefolium*), known also as salad chervil, a small, fine-leaved annual of the PARSLEY family, native to eastern Europe and adjacent Asia, often grown in vegetable gardens and used like parsley. The turnip-rooted chervil (*Cherophyllum bulbosum*) is a biennial plant, also of the parsley family and native to Europe, cultivated for its edible fleshy root.

**CHESAPEAKE AND OHIO CANAL**, built, 1828-51, from Georgetown to Cumberland, Md., following the Potomac River; it was projected, but never constructed, from Cumberland to Pittsburgh. Friends of the plan to divert the commerce of the Ohio valley and western Pennsylvania to the Chesapeake region by means of a canal across the mountains (an elaboration of the POTOMAC COMPANY project), meeting in convention at Washington, Nov. 6-8, 1823, secured the cooperation of Maryland by proposing to include Baltimore as an eastern terminus, and solicited the cooperation of Ohio for ultimate connection of the canal with Lake Erie. The Chesapeake and Ohio Canal Co., incorporated 1824-25 by the legislatures of Virginia, Maryland and Pennsylvania, was capitalized at \$6,000,000, with stock in the Potomac Co. accepted for exchange at par. The Federal Government subscribed \$1,000,000. Engineers headed by Gen. Simon Bernard dismayed the capitalists by reporting plans for a canal from Georgetown to Pittsburgh estimated at \$20,000,000; a second commission optimistically reduced the estimate by half, and work began.

The canal company and the Baltimore and Ohio Railroad, incorporated in 1827-28, engaged in continuously bitter rivalry, particularly over right of way

between Harper's Ferry and Point of Rocks. The canal almost incessantly required additional capital; after 1833 Maryland alone supported the work, and had expended \$7,000,000 when, in 1846, the state executed a mortgage upon the canal. There were then about 18 miles yet to be constructed, to Cumberland; the work was completed by private contractors by 1851. The aggregate actual cost of construction was \$11,071,176.21. Appointment of canal officials became a perquisite of the Democratic party in Maryland. Treated as part of the patronage, the canal was a financial failure, and was abandoned in 1889. Repairs were made and traffic resumed in 1891 after bondholders had interceded in the courts to prevent sale of the canal for \$200,000 to the Virginia Central Railway. It is currently used especially for transportation of coal from the Cumberland region to the Potomac.

**CHESAPEAKE and SHANNON**, two warships which engaged in a famous encounter in the WAR OF 1812, on June 1, 1813. Capt. Broke, commanding the British frigate *Shannon*, with 52 guns and 300 men, off Boston, addressed a challenge to Capt. Lawrence, commanding the *Chesapeake*, with 49 guns, in Boston harbor. Handicapped by a surly crew, the *Chesapeake* sailed out. The vessels withheld fire until within pistol-shot distance, then opened a destructive cannonade. After 12 minutes the *Chesapeake*, seriously crippled, did not obey the helm, and fouled its mizzen rigging on the *Shannon's* fore-chains. Thus entangled, it was helpless against the enemy's raking fire. Lawrence was attempting futilely to deliver orders above the din of battle when he was mortally wounded; his last words as he was carried below decks were, in substance, "Don't give up the ship!" The British boarded the *Chesapeake*, and were aided in a quick capture by the mutiny of part of the American crew. The *Chesapeake* had lost 48 men killed and 98 wounded; the *Shannon* 26 killed and 58 wounded.

**CHESAPEAKE BAY**, a large inlet penetrating the Atlantic coast of the United States. With its length of almost 200 mi. it cuts off a small portion of Virginia and extends into Maryland nearly to the northern boundary. In width it averages 20 mi. The main body of water has numerous arms which are chiefly estuaries of rivers such as the Susquehanna, Potomac, Rappahannock, York and James. Its chief harbors are Baltimore and Norfolk which is also a naval base. The bay is noted for its extensive oyster beds and for the waterfowl which frequent its waters.

**CHESAPEAKE-LEOPARD AFFAIR**. Early in 1807 several French frigates, seeking refuge from a gale, entered Chesapeake Bay, and shortly were blockaded by an English squadron. A boat's crew deserted one of the British ships, and escaped to Norfolk. It was thought to have enlisted on the American frigate *Chesapeake*, then fitting out at Washington for a cruise to the Mediterranean. The commander of British operations in the western Atlantic issued a circular order directing that British ships meet-

ing the *Chesapeake* at sea exercise the right of IMPRESSMENT AND SEARCH to reclaim the deserters. On June 22 the British frigate *Leopard*, pursuant to these orders, intercepted the *Chesapeake*. Capt. Barron, commanding the American frigate, stated that he knew of no such men as were described in the British order, and would not permit his crew to be mustered. Capt. Humphreys, of the *Leopard*, thereupon directed three broadsides against the *Chesapeake* before the American vessel had time to clear its guns. The *Chesapeake* surrendered, and the British mustered the American crew, reclaiming four deserters, three of whom were actually of American citizenship; but Capt. Humphreys refused to accept the surrender. The *Chesapeake* drifted back to Hampton Roads; Capt. Barron, tried by court-martial, was suspended for five years for his dereliction in not preparing for action instantly on receipt of the British order. The affair created intense excitement in the United States. President Jefferson's moderation offset the demand for immediate war with Great Britain as a result of this affair and similar incidents.

**CHESS**, a game for two persons, played on a special board with 32 pieces. Its name is derived from the Persian *shah*, meaning king, the designation of the most vital piece in chess. The euphonic kinship between the Persian *shah mat*, meaning, the king is dead!, and the English checkmate, by which operation chess games are won, is apparent at once. Beyond

evidence that the game was held in high favor by the Persians, little of a factual nature is known about the early history of chess. It was unquestionably played several centuries before Christ by the Hindus, Greeks, Romans, Egyptians, Chinese, Arabians and other races. The game was introduced into Europe in the 7th century, after the Arab conquest of Persia, and has since undergone great refinement of principle and play.

But further researches into the early history of

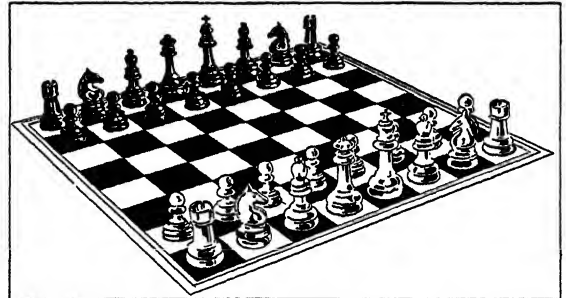


ANCIENT CHESS PLAY  
From a miniature in the  
Harleian collection

chess will scarcely repay the student interested chiefly in ascertainable fact, for chess is saturated with legend and fantasy and invention. Every age has lent some of its color to a game which, despite its fairly intellectual character, has gained steadily in universal favor. The chronicles of India, the classic prose and verse of Greece and Rome, and the light literatures of the Middle Ages, are replete in allusions to chess. In later times, its symmetry and order, combined with its classic associations, appealed to the Renaissance mind of the 15th and 16th centuries. Its logic and mathematical complexion allured even the Continental rationalists of the 18th century, to whom most so-called

games were anathema. Even the hurried tempo of 20th century society has not lessened the appeal of a game which primarily demands a leisurely and meditative consideration. The only explanation of this enduring and mounting favor is that chess is a microcosm, a little world in which man may see both the rude and the subtle forces around him in the larger world. The analogy is a fair one. The extent of a chess player's ingenuity in escaping from checkmate may well be a test of his resourcefulness in dealing with more realistic issues in his existence. But beyond such philosophical aspects, chess is as near the perfect game as man has devised. It is a contest of skill in which luck plays no part. It provides the excitement of combat in infinite variety. It is not dependent upon weather or season, and its only material requirements are a board and chessmen, whose cost is nominal.

**The Board and Pieces.** The chessboard is a rectangle divided into 64 squares of alternate colors, the same field of battle used in checkers. It is laid so that a white square is at the right-hand end of the first row facing each player. The opponents each have 16 pieces, or men, arranged at the outset of the game on the first two rows facing each player. The major pieces are laid on the first row, and the pawns on the second.



COURTESY ROLLAND F. MCCRILLIS CO., NORWALK, O.

CHESSBOARD WITH CHESSMEN AT START OF GAME

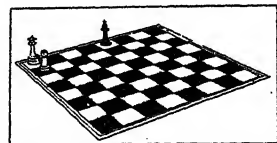
Each player has a king; queen; two rooks, sometimes called castles; two bishops; two knights, sometimes called horses; and eight pawns. When the pieces are set up at the start of the game, the queen is placed on a square corresponding to her color, i.e., the white queen is placed on a white square in the center of the first row.

To understand the fairly complex moves of the chessmen, the beginner should know immediately that the objective of the game is to hem in the king in such fashion that the square on which he stands is under attack, as are the only adjoining squares to which he can move. Thus trapped, the king is checkmated, and the opposing player wins the game. It will be seen that strategy is the very essence of chess movements. The strategical possibilities inherent in the pieces arise from the fact that each class of chessmen has, unlike checkers for example, a highly individualized mode of movement, and except for the queen, that mode only.

**Rules of Game.** The king may move one square in any direction, unless the adjoining square is threatened by an opposing piece. The queen, most mobile and dangerous of all pieces, may move any number of squares in any direction over unoccupied squares. It may take an opposing piece at the end of its line of movement (only done if it is safe from fatal reprisals), but it is stopped by an intervening piece of its own color. The queen combines the circumscribed movements of the rook and bishop. The rook moves parallel with the sides and ends of the board, and never diagonally. The bishop moves diagonally, and never parallel with the board. The knights, elastic and elusive weapons, move in a peculiar manner that permits of infinite offensive and defensive combinations. A knight moves in an L-shaped course, two squares forward, backward, or to the side, and one square at right angles to the first movement, or vice versa. To attain an unoccupied square, the knight may, if necessary, leap over intervening pieces; the fact that it moves three squares means that this piece invariably lands on a square opposite in color to the one it left.

The power of the pawn transcends the sacrificial role accorded it in literature, for in chess strategy these eight little men not only may comprise a thorny defense, but may be used offensively to break up threatened attacks. In its first move, the pawn has the option to advance one or two squares directly forward. Thereafter it may progress one square only. It may move one square diagonally to capture an opposing piece. If it succeeds in advancing to the first row of the enemy, it may be exchanged for any piece of the same color, except the king. Thus a player may have two queens simultaneously. In addition, the pawn is endowed with the usual ability of taking *en passant*; this occurs when a pawn, in moving two squares, passes the diagonal of an opponent's pawn, in which event the latter may take it in passing by moving on to the square it crossed. Finally, the king and either rook are susceptible of a defensive manœuvre known as castling, commonly executed early in the game, if at all. This consists of a transposition of the king two squares laterally, and of the rook, on the side to which

the king moves, to the square next and off-side of the king. Castling is permitted only once, and may not be made if the king has been moved, or if castling moves across or to a threatened square, or with a rook that has been moved. To check the king is to move



CHESS BOARD SHOWING CHECK-MATE

Simple checkmate of Black king by white queen and rook

an opposing piece so that it bears on the king, in which case the latter must be moved out of check. A simple checkmate, or win, defined in the foregoing, is illustrated in the accompanying figure.

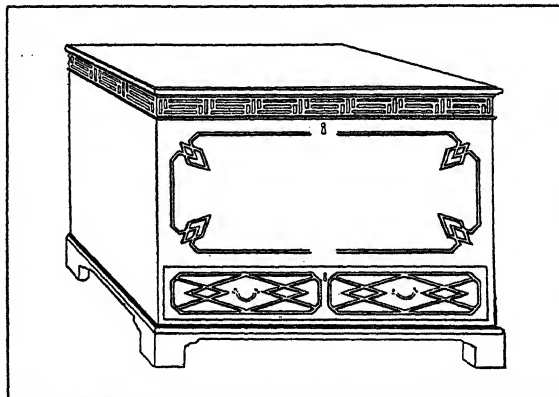
The players move alternately, and the game is invariably opened by white. To determine which opponent plays white, one of the players extends to the

other his closed fists, each holding a pawn of alternate colors. The player uses the color he draws. A player touching a piece must play it, unless he declares "*j'a-doube*", I adjust. A move is completed when the player has removed his hand. A stalemate is declared when a player's king, while not in check, cannot move it or any piece on the board without becoming in check. In this event, the game is considered a draw.

**Chess Problems.** To work out chess problems, the beginner must first master the English system of chessboard notation. This consists of a simple system of numbered squares. The squares in the field are numbered 1-8, and designated by the identity of the respective pieces at either end of a row. Thus the fourth square in front of the queen is written Q4. The major chessmen on the queen's flank are designated queen's bishop (QB), queen's knight (QKt), etc., and likewise for the king's bishop (KB), etc. In this way, the move of the queen's bishop to the queen's fourth square is written QB-Q4. A cross indicates capture of a piece; QxP means that the queen takes an opposing pawn. Chess problems consist of given deployment of pieces, with such instruction, for example, as, "White to move and mate in three moves."

**BIBLIOGRAPHY.**—For instruction generally see J. R. Capablanca, *Chess Fundamentals*, 1921. In the fascinating department of chess strategy, requiring only one player, the student will find enlightening problems in F. B. Feast, *Simple Two-Move Themes*, 1924.

**CHEST**, a covered wooden box for the safe-keeping of valuables. It is doubtless the oldest form of household furniture, and from its primary use as above and its secondary uses as seat, bed and table have evolved the bench, settle, chair, cupboard, buffet, cabinet, chest of drawers and numerous other pieces. Until comparatively modern times only the rich had furniture in the ordinary sense, but every family had a chest, if only a hollowed oak log banded with iron.



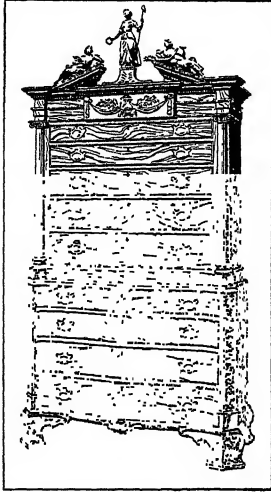
COURTESY M. M. OF ART

DRAWING FOR A CHEST TAKEN FROM THE SCRAP BOOK OF THOMAS CHIPPENDALE

Ancient Egyptian and Assyrian chests, of which there are specimens in the Louvre Museum more than 4,000 years old, were made of cedar or teakwood, inlaid with ebony and ivory. The Greeks carved their chests with graceful figures. The Gothic period developed a great



variety of beautiful decorations, largely of architectural design, consisting of paneled carving, marquetry, painting, colored and gilded plaster moulding, iron bands and hinges ending in foliated scrolls, the latter being sometimes plated and applied over velvet. The elaborately carved and gilded chests of the Italian Renaissance were genuine works of art.



COURTESY M. M. OF ART

AMERICAN MAHOGANY  
CHEST-ON-CHEST

When it was found more convenient to open the chest by doors or drawers in front rather than by a lid, and when legs were added, the evolution of the chest into other forms of furniture had begun. (See BENCH; BUFFET; CHAIR; CUPBOARD; SETTLE.) The early form of chest is, however, still in common use to-day, e.g. the tool chest, the traveling trunk, the box couch and the familiar cedar chest.

**CHESTER**, a county town, city and county borough of Cheshire, England, 16 mi. south of Liverpool. It lies on the river Dee in flat country. Chester is Roman in plan, having four main streets crossing centrally at right angles, and leading to four gates in the walls that are the only ones remaining complete in England to-day. The famous and picturesque Rows are open galleries serving as footpaths through the fronts of the houses at several feet above the road which is reached at intervals by steps. The Rows are flagged and ceiled, and their ancient oaken rails might be mistaken for stone. In Chester, Roman and later remains are abundant. The Saxon Church of St. John, rebuilt during the Norman period, is associated with Leofric, husband of Lady Godiva. The present cathedral stands on the site of a Druidical shrine and of a later Roman temple to Apollo, and presents some beautiful examples of Norman, Decorated and Perpendicular architecture. The city is rich in 17th century and earlier, half-timbered houses, one of which is the quaint God's Providence House commemorating the escape of its inmates from the plague of 1652. In Roodee Meadow outside the city walls is a famous racecourse where races have been held since 1609. Chester's interests are largely in tourist and antique furniture traffic, and it has many trade guilds. Pop. 1921, 40,802; 1931, 41,438.

**CHESTER**, a city in Delaware Co., southeastern Pennsylvania. It is situated on the Delaware River, 13 mi. southwest of Philadelphia and is served by bus and truck lines, steamships and three railroads. Chester has a large shipbuilding industry, an automobile assembling and shipping business, steel plants and other important manufacturing establishments. In 1929 the total industrial output was worth about

\$111,000,000; the retail trade amounted to \$29,516,939. The city is the seat of the Pennsylvania Military College and the Crozer Theological Seminary. Chester was the first settlement in Pennsylvania; it was founded by the Swedes in 1645. William Penn came here in 1682. Washington quartered his troops here after the Battle of Brandywine. The city was chartered in 1866. Pop. 1920, 58,030; 1930, 59,104.

**CHESTER**, a city and the county seat of Chester Co. in northern South Carolina, situated 60 mi. northwest of Columbia. Bus lines and four railroads serve the city. Cotton and live stock are raised in the vicinity and cotton manufacture is the chief local industry. The city was founded by Scotch-Irish settlers in 1785. Pop. 1920, 5,557; 1930, 5,528.

**CHESTER CATHEDRAL**, Chester, England, built of red sandstone and seen to picturesque advantage from the city walls, an interesting structure which combines various styles and has several features of great beauty. The oldest part, the north transept, contains work begun in 1093. The finest building, however, was done between 1200 and 1315. There is a lady chapel in pure Early English, and a graceful rectangular chapter house dating from 1240-50. The Early English refectory adjoining the cloisters contains an admirable reader's pulpit. The nave is chiefly in early Decorated, a style which finds better expression, however, in the richly adorned choir. The nave vault, by Sir Gilbert Scott, is modern. The carved choir stalls are surpassed in England only by those of Lincoln Cathedral. The central tower, in the Perpendicular style, was erected in the 14th and 15th centuries.

A curious feature of Chester Cathedral is the disproportionate size of the south transept, which is as large as the choir and four times the size of the north transept. In the 14th century the monks wished to enlarge their church, and since they were blocked to the north by their own cloister and chapter house, annexed the site of St. Oswald's Church to the south, and erected a new church elsewhere for the parishioners. In the 15th century the congregation claimed the south transept as their church; and until 1874 it was walled off from the rest of the cathedral and used for this purpose.

**CHESTERFIELD, PHILIP DORMER STANHOPE, EARL OF** (1694-1773), English statesman, was born at London on Sept. 22, 1694. Begun privately, his education was completed with approximately one year at Cambridge, during which he became an excellent student of languages. Having traveled extensively on the Continent, he returned to England to become a member of the household of the Prince of Wales. Elected to the House of Commons in 1715, he represented St. Germans until 1726, when he became Earl of Chesterfield and entered the House of Lords. In 1728 he received the Garter for his services as ambassador to The Hague. During the domination of Walpole under George II Chesterfield was the prime minister's vigorous opponent, be-

ing largely responsible for his downfall in 1742. Under the Pitt ministry Chesterfield again went to The Hague as ambassador, receiving for persuading the Dutch to enter the WAR OF THE AUSTRIAN SUCCESSION the lord-lieutenancy of Ireland. His governorship in Ireland, 1745-46, was the most brilliant part of his political life. He retired after 1751.

Chesterfield is chiefly famous to-day for his *Letters to his Son*, written to his illegitimate child, Philip Stanhope, to whom he was devoted. These letters were begun when the boy was five years old and continued through his early manhood. Chesterfield is also known in the history of literature for his association with SAMUEL JOHNSON, who rebuked him for his indifference to the *Dictionary of the English Language*. The statesman died on Mar. 24, 1773.

**CHESTERFIELD**, a municipal borough of Derbyshire, England, lying in an industrial district 24 mi. northeast of Derby at the junction of the Rother and Hipper rivers. To-day, though a thriving, modern city, it retains an ancient character in its irregular streets and old buildings. The fine Church of St. Mary and All Saints boasts an apsidal Decorated chapel, and a lead-covered, wooden spire 230 ft. high, remarkably twisted. Among other buildings of interest are the 16th century grammar school and the Stephenson Memorial Hall, 1879, commemorating George Stephenson, the engineer, who passed his last years near Chesterfield. The town's growth paralleled the development of the cotton and silk industries which still prosper together with manufactures of earthenware and machinery, and brass and iron founding. Coal, iron and lead are mined in the vicinity. Pop. 1921, 61,232; 1931, 64,146.

**CHESTERFIELD HOUSE**, a mansion in MAYFAIR, London, famous as the residence of Philip Dormer Stanhope, 3rd Earl of Chesterfield (1694-1773), author of the celebrated *Letters To My Son*, published 1744. Built in 1750 by Isaac Ware, it was owned by the earls of Chesterfield till 1850, becoming later the residence of the Duke of Abercorn and, later still, of Lord Burton.

**CHESTERTON, GILBERT KEITH** (1874- ), British author and lecturer, was born in London, May 29, 1874. He left school at 17, studied art, drifted into journalism and thence into a literary career. He produced a great volume of work of exceedingly varied character, including essays, criticism, verse and fiction. Among his critical works are *Robert Browning*, 1903, the notable *Charles Dickens*, 1906, *The Victorian Age in Literature*, *William Cobbett*, 1925, and *R. L. Stevenson*, 1927. Among his many novels the best known are the *Father Brown* series of detective stories and *The Man Who Was Thursday*, 1908. As a humorous poet he has few equals, and is especially noted for his *Ballad of the White Horse* and *Wine, Water and Song*, 1915. In 1922 Chesterton was received into the Catholic Church and his ardent faith was subsequently evident in much of his work; among the direct results is his study of *St. Francis of Assisi*, 1923. In both lectures and

writings he championed the cause of Christian Socialism. An unusually brilliant stylist, Chesterton is renowned for his effective use of the paradox.

**CHESTNUT** (*Castanea*), the name given to several handsome trees of the beech family, native to north temperate regions, highly prized for their edible nuts. The Old World chestnut (*C. sativa*), native from the Mediterranean region to China, is widely grown for food in Europe. It is a stately tree, sometimes 80 ft. high, with a spreading compact head, large, sharply toothed leaves and showy spikes of flowers appearing in early summer. The fruit, ripening in autumn, consists of a large prickly bur, enclosing 2 to 5 nuts, more than an inch across. The coarse-grained wood, rich in tannin, and very durable in contact with wet soil, is used for fence posts and hop poles.

The very similar American chestnut (*C. dentata*), a magnificent round-topped tree, sometimes 100 ft. high, is the tallest and hardiest of the chestnuts. It is native from Maine to Michigan and southward to Florida and Mississippi, and sparingly planted for ornament. Though smaller in size, the nuts are better flavored than those of the European species. The soft, reddish-brown wood is used for furniture, interior finishings and railway ties. In many sections the American chestnut has been largely exterminated by the attacks of a fungus (*Endothia parasitica*). The nuts of two Asiatic species (*C. crenata* and *C. mollissima*) are important articles of food in China and Japan.

**CHESTNUT EXTRACT**, the water extract from the wood of chestnut trees found in the United States, France, Italy and Spain. North Carolina produces over 50% of the world's supply. When treated with small amounts of raw blood albumin, it is decolorized and becomes mellow; tanning sole leather is its chief use. It is usually blended with other tanning extracts, especially Quebracho. See also TANNIN.

**CHETCO**, a name applied to a former group of nine Athapascan villages at the mouth of the Chetco River, Ore. After the destruction of their villages by whites in 1853, the Chetco were removed to the Siletz Reservation in Oregon. They resembled the Athapascan Tolowa of California, both in language and culture.

**CHEVALIER, MICHEL** (1806-79), French economist, was born at Limoges, Jan. 13, 1806. In 1832 he was sent to the United States by Thiers, minister of the interior, to study land and water transport. His *Lettres sur l'Amerique* were published in 1836. He was instrumental in concluding the Cobden commercial treaty with France, in 1860, and was elected to the Senate in the same year. One of his chief writings, *On the Probable Fall of the Value of Gold*, was translated by RICHARD COBDEN in 1859. He died at Montpellier, Nov. 28, 1879.

**CHEVAUX DE FRISE**, portable barriers to roads, streets or passageways, usually about 12 ft. long and 3 ft. high, formed by stringing barbed wire longitudinally and diagonally on frames consisting of hori-

zontal members resting in the crotches of crossed supports.

**CHEVIOT**, a residential suburb of Cincinnati, O., situated 6 mi. from that city and served by the Chesapeake and Ohio Railroad. There also is an airport. Pop. 1920, 4,108; 1930, 8,046.

**CHEVIOT HILLS**, a range of mountains stretching 36 mi. from northeast to southwest extending from Northumberland, England, to Roxburgh, Scotland. Limestone is the chief rock constituent of the main structure of the range but the most prominent elevations, located in the northeast, are of trap and granite. The greatest heights are attained in Cheviot Peak, 2,676 ft. Cairn Hill, 2,545 ft. and Carter Fell 2,020 ft. The hills provide pasture for sheep and were the locale of many of the battles in the border wars. From Newcastle to Jedburgh by the pass of Carter Bar is spread the sole highroad in these hills and south of Carter Fell climbing the valleys of the North Tyne and Liddell Water runs a branch of the North British Railway. The affluents of the Tweed have their sources in the northern slopes; the sources of the Till, North Tyne and Coquet are in the southern.

**CHEVRON**, a prescribed device, consisting, in general, of two or more bars meeting at an angle, worn by members of the military or naval establishment in uniform to indicate the wearer's grade, the fact that he rendered service in the military or naval forces of the United States in time of war, or the fact that he was wounded in action against an enemy.

Chevrons denoting grade or rank are worn on both sleeves, points up, above the elbow, by soldiers or sailors serving as noncommissioned officers, and by cadets or midshipmen serving as cadet officers or noncommissioned officers. To indicate service in a theater of operations during the World War by a uniformed member of the military and naval establishments of the United States, a chevron is worn on the left sleeve, point down, below the elbow: Of gold, one bar for each complete period of six months of such service; or of sky blue, one bar, when the aggregate of all such service is less than six months. A wound chevron is worn on the right sleeve, point down, below the elbow, by a uniformed member of the military and naval establishments who while serving as such sustained a wound in action with an enemy of the United States—one bar for each occasion upon which such a wound was received. E. A. K.

**CHEVRONETZ**, a unit of money in Russia which is equivalent to ten pre-war rubles or about \$5.15. It was introduced in 1922 as one of the measures of economic reconstruction, and its issue has been restricted to maintain its value. Chevronetz notes have been issued by the state bank with sufficient backing to make them stable currency.

**CHEVROTAIN**, the tiny hornless "mouse deer," of the family *Tragulidae*. The typical genus (*Tragulus*), oriental in range, includes the Malayan kanchil. This exquisite little creature stands 12 in. high, and weighs but 5 to 6 lbs. It has a reddish-brown coat with white markings, a small, pointed

head, large eyes, and pipestem legs. The Asiatic chevrotain is somewhat larger. These animals exhibit more primitive dentition, and simpler foot and stomach structure than true deer and are classed as intermediate between the pigs and the ruminants.

**CHEWING GUM**, a preparation of some elastic gum resin or wax, or a combination of these to which sugar and flavoring have been added. Although natives of Central America have long used chicle resin for this purpose, true chewing gum was developed in the United States, where its use is a national habit.

The resin of the black spruce (*Abies niger*) was the first chewing gum, the clarified resin being used alone or mixed with a little paraffin wax. This product is still popular in New England. Paraffin wax with added sugar, flavor and color, sweet gum (*Liquidambar Styraciflua*) and tamarack (*Larix americana*) have also served as chewing gums.

To-day the most important resin used in manufacturing chewing gum is CHICLE, the elastic gum from the sapodilla or naseberry tree (*Achras Sapota*) of Central and South America. This tree resembles the India rubber tree. In Central America, the gum is allowed to oxidize and is then melted in crude ovens and flavored with brown sugar; in North America, large machine-equipped factories produce chewing gums of a dozen types and flavors. Chewing gum is harmless and may aid digestion by mechanically increasing the amount of saliva. Pepsin is often added as a digestive aid, but is of little value.

**CHEWINK**, a name given to the towhee (*Pipilo erythrophthalmus*), a common songbird of eastern North America, because of one of its notes. See TOWHEE.

**CHEYENNE**, a typical tribe of the North American Plains speaking a dialect of the ALGONKIAN linguistic stock. When first known their territory was in Minnesota, but they were gradually forced westward toward the Missouri River and to the Cheyenne River in South Dakota, where they were visited by Lewis and Clarke in 1804. In their original habitat they lived in permanent earth-lodge villages. They were agriculturists and potters, but when driven to the plains became nomadic buffalo-hunters. Early in the 19th century, the Cheyenne were separated into two divisions: the northern, who roamed around the headwaters of the North Platte and the Yellowstone, and now live on a reservation in Montana, and the southern Cheyenne, who lived in southeastern Colorado and now on a reservation in Oklahoma. Culturally they resemble most closely the Dakota, and their confederates, the Arapaho.

**CHEYENNE**, the capital of Wyoming, and the county seat of Laramie Co., situated in the southeastern part of the state, about 100 mi. north of Denver, Colo. It is served by three railroads and three air lines and has one of the best-equipped airports in the country. The city has an altitude of 6,058 ft., and is surrounded by broad, rolling plains. Cheyenne is a shipping point and trade center for a wheat-growing

and cattle-ranching district. Iron and lime deposits are found near by. The city has various factories, also packing houses and the Union Pacific Railroad shops. In 1929 the value of the factory output was about \$5,000,000; the retail trade amounted to \$13,520,410. Every summer the Frontier Days Celebration is held here for five days, with an annual gathering of Indians, plainsmen and cowboys who give unique exhibitions of Old West life. Ft. Francis E. Warren, a military reserve, is located immediately northwest. Cheyenne was laid out by the Union Pacific engineers and army officers in 1867; it was incorporated and made the capital city in 1869. Pop. 1920, 13,829; 1930, 17,361.

**CHEYENNE RIVER**, a river of South Dakota, formed by two branches rising in northeastern Wyoming. The north branch, called the Belle Fourche, runs directly northeast into South Dakota and skirts the northern base of the Black Hills. The southern fork flows eastward into South Dakota, passes the Black Hills on the south and traverses the Bad Lands before uniting with the Belle Fourche on the boundary line between Pennington and Meade counties. The main river flows northeast and discharges into the Missouri at the northeast extremity of Stanley Co. Each branch is about 350 mi. long and the main stream 150 mi.

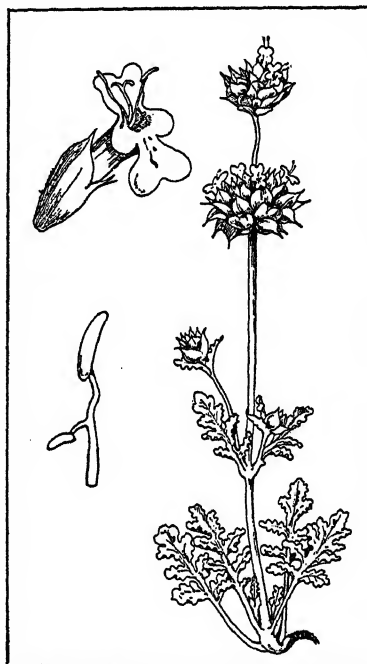
**CHEYNE, THOMAS KELLY** (1841-1915), English Bible student born Sept. 18, 1841 in London. Trained at Oxford and Göttingen, he was a pioneer in England in the work of modern Old Testament criticism. He was ordained in 1864. Except for the years 1881-85, when he was rector of Tendring in Essex, his work was at Oxford, where he held a fellowship 1868-82, and the Oriel professorship of Scripture interpretation 1885-1908. He delivered the Bampton lectures in 1889, wrote much on Old Testament themes, and was joint editor of the *Encyclopaedia Biblica* (1889-1903). He died Feb. 16, 1915.

**CHEYNE WALK** (pronounced Chā-nē), a picturesque street in Chelsea, London, extending from Cremorne Road to the old Physic Garden, on the north bank of the Thames, famous for the great number of artists and writers who have inhabited it. Formerly called Lindsay Row but renamed in honor of Lord Cheyne, owner of Chelsea Manor in the 17th century, it is one of the most charming streets in London, quiet and dignified, with many fine 18th century gates and wrought-iron railings. Of those who have lived there the most noteworthy are J. M. W. Turner, the painter; George Eliot, the novelist, who died at No. 4 in 1880; D. G. Rossetti, the poet and painter, at No. 16, where also lived Swinburne and George Meredith; and Thomas Carlyle, who lived at No. 24 Cheyne Row.

**CHIA** (*Salvia Columbaria*), a small annual of the mint family, native to the southwestern United States. It grows about a foot high, bearing wrinkled, much divided, mostly basal leaves and two-lipped, bright blue flowers in one or two dense whorls. The highly nutritive, mucilaginous seeds, valued medicinally by

the early Mission Fathers in California, were used for food by the Indians.

**CHIANG KAI-SHEK** (1886- ), head of the Chinese Government, was born in the province of Chekiang in 1886. He is a graduate of Tokyo Military College, and was a member of Sun Yat-Sen's revolutionary party before 1911. He took an active part in the revolutionary movements of 1911 and 1912, and became one of Sun Yat-Sen's associates. In 1923 he went to Soviet Russia to make further military studies. Returning to China the next year, he became the leader in the organization of the Nationalist forces, working with Borodin in developing the military expedition which started northward in 1926. After this expedition had secured control of Shanghai in Mar., 1927, Chiang led the Moderates



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

CHIA

Flower, stamen and plant in flower

in the National party in the break with Soviet Russia. When the Nationalist Government was formally established on Oct. 10, 1928, Chiang was made Chairman of the state council, and as such became the head of the government. He retained his position of Commander-in-chief. He successfully resisted several efforts to overthrow his administration, but on Dec. 10, 1931, he resigned as head of the state and Commander-in-chief in order, he said, to clear the way for unification of the country. A good deal of opposition to him had developed on the ground that he was too dictatorial.

**CHIANG MENG-LING** or **MONLIN** (1884- ), Chinese educator, was born in Chekiang province. After studying at California and Columbia universities (Ph.D. Columbia, 1917), he returned to China and from 1919-26 he served as action chancellor of the

National University at Peking. Upon the break-up of the university, due to lack of funds, he returned to his native province. He was minister of education in the National Government at Nanking from 1928 to 1930, when he became chancellor of the reorganized National University at Peking. He has been a member of the central political council of the Kuomintang and has been one of the most influential leaders for modern education in China.

**CHIAPAS**, a state of Mexico, situated on the Yucatán peninsula, the most southern of the states of the republic. It has an area of 27,527 sq. mi., much of which is still unexplored. The southern section of the state is traversed by the Sierra Madre Mountains, to within a few miles of the coast. This strip of land is very fertile. The chief rivers are the Usumacinta, Mezcalapa Blanquillo and Tulija. Its many ruins are world renowned, and their construction leads scientists to believe them to have been the habitation of a very highly civilized race, while their age indicates the place to have been the cradle of the human race. The most noted of these ruins are Palenque and Oocingo. Coffee, rubber and cacao are produced. The capital is Tuxtla Gutierrez; other cities are Tonalá, and Comitán. Pop. 1921, 421,744; 1930, 521,318.

**CHIAROSCURO**, the balance of light and shade in a picture. The term applies specifically to a manner of wood-engraving developed early in the 16th century, which constituted the first step in color-printing. The black line-design was printed over a flat tone applied from a tint-block, in which the high lights were incised as strong white lines. As many as four tints were sometimes used, the darker over the lighter, in reproducing flat tinted drawings. In Rudolph Ruzicka the United States has a modern exponent of a manner perfected by Lucas Cranach (1472-1553), Hans Baldung Grien (1476-1547), Jost de Necker and Ugo da Carpi.

**CHIBCHAN**, a South American linguistic stock comprising a large group of tribes whose dominion at the time of the Spanish Conquest in 1538, centered around the plateau of Bogota. When the Spanish appeared, the Chibcha nation or Muysca, as it is frequently called by Spanish writers, had established a hegemony over neighboring peoples and were well on their way to the foundation of an empire. Their ruling princes were despots. Agriculture was the basis of the economic life of the Chibcha. Traders journeyed as far north as Santa Marta and as far south as Quito to barter salt, gold, and woolen stuffs. Gold was found in large quantities in the rivers. According to narrations of early explorers, doorways were encrusted with gold leaf and, at an annual ceremony, the body of the priest-king was completely covered with gold dust before he bathed in the sacred waters of a lagoon. Chibchan gold bolstered the European belief in the existence of El Dorado.

**CHICAGO**, 2nd largest city of the United States, is the leading railroad center of the country and the chief market for the agricultural products of the Central Plains. The seat of Cook Co., Ill., Chicago

is situated on the southwest shore of Lake Michigan. In 1920 the population was 2,701,705; in 1930, 3,376,438, an increase of 25% in ten years. The 14th Census, 1920, numbered the foreign population of Chicago at 805,482 and the Negro population at 136,396. The diffuse racial character of the city is evident in the fact that 40 languages are spoken. In January the average temperature at Chicago is 25° F., in July 74° F.; average annual precipitation, 32.9 in.

**Geographic Setting.** Unlike New York, Chicago's growth has not been restricted by the terrain, but its development has met with other natural obstacles. Chief among these is its location on the low plain once covered by the lake which borders Lake Michigan on the southwest. The ground is not firm due to its sandy and clayey character, thus necessitating considerable filling in of land. The business district has been raised from 7 to 25 ft. above the lake level, in order to prevent water infiltration and to permit the construction of tall buildings on the unstable foundation. Chicago has no natural harbor, but by widening and deepening the mouth of the Chicago River and protecting it by breakwaters, an excellent harbor has been made. The river itself, which used to flow into the lake, was reversed in 1900 and at the same time transformed into a drainage canal by which the waters of Lake Michigan flow southwestward into the Illinois River and finally into the Mississippi. At a point about a mile west of the lake shore, two tributaries of the Chicago River join. The one from the southwest now constitutes the drainage canal and separates the "West Side" of Chicago from the "South Side." The tributary from the northwest is the boundary between the North and West "sides." Thus the drainage system marks off the three main districts of Chicago. By absorbing suburbs and by other annexations, Chicago in 1930 attained an area of 208.61 sq. mi., along the crescent-shaped shore for 26.5 mi. and inland for about 10 mi.

Until 1890, Lake Michigan and the Illinois and Michigan Canal received Chicago's sewage. In that year a sanitary district for the whole of the city and some of its suburbs was mapped out, and several years later construction was begun on the great new drainage canal joining the south branch of the Chicago River with the Des Plaines River. Water from the lake flushes the canal, a circumstance that has given rise to much criticism as it is believed that the lake level is materially lowered by the sewage flow.

**Government.** The city of Chicago embraces about 75% of the area covered by Cook Co. The municipality operates under a state charter granted in 1876, now considerably revised. The chief executive officer is the mayor, who presides over a common council comprised of an alderman from each of the 50 wards. The council has the power to pass legislation over the mayor's head by a vote of two-thirds of its members. Heads of the departments of education, sanitation, law, and other city departments are appointed by the mayor, but such appointments must be confirmed by the council. Cook Co. officials are headed by



the president of the board of county commissioners.

**Industry.** The location of Chicago at the head of Lake Michigan, and in the approximate center of an enormously rich agricultural, stock-raising, coal-mining and steel-manufacturing country, is the explanation of the immense industrial and commercial growth of the city in the 20th century. In 1930 Chicago was the world's greatest grain and live stock market and center of the meat-packing industry. In the same year its manufactures in order of importance were meat and animal products, electrical machinery, railway cars, men's clothing, women's clothing, bakery products, foundry products and iron and steel products. In 1929 total manufactures were valued approximately at \$3,000,000,000; the retail trade amounted to \$2,153,626,553; the wholesale trade proper, to \$2,492,140,478. In 1930 the wholesale trade of Cook Co., all establishments, was valued at approximately \$5,928,994,384. In addition to the extensive stockyards, the plants of the International Harvester Co., Western Electric Co. and the Pullman Co. are located in Chicago. In 1929 its exports were valued at \$9,049,392. An enormous mail order business is transacted annually by Sears, Roebuck and Co., Montgomery Ward and Co. and other retail houses.

**Transportation.** The greatest inland market in the United States, Chicago is served by 38 railroads from every agricultural and industrial section of the nation. The chief lines are the Michigan Central system from the east, the Chicago and Northwestern, Atchison, Topeka and Santa Fé, and the Chicago, Rock Island and Pacific networks from the west, the Canadian Pacific, by way of subsidiaries from the north, and the Illinois Central from the south. The Chicago Union Passenger Station was completed in 1925. Other large terminals are the Central, the Chicago and Northwestern Grand Central and the La Salle Street stations. The completion of the Illinois Waterway System will connect Chicago by way of a barge canal between the Chicago and Illinois rivers with the Mississippi and New Orleans. The iron, steel, and cement plants immediately south of the city depend to a large extent upon shipping to obtain raw materials from ports on the Great Lakes. In 1931 Chicago was the destination of a freighter from a European port, arriving by way of the St. Lawrence River and the Welland Canal. The city is the center of the middle west airway network and is on the transcontinental air route. Within the city, and serving the South Side, the Illinois Central suburban system, electrified in 1926 at a cost of \$40,000,000, conveys passenger traffic along the lake shore from Matteson, Ill., beyond the southern limits, to Randolph Street in the heart of the city. North, West and South sides are served by bus systems, elevated trains and by the street cars which cover 1,350 mi. A passenger subway system has been deemed impractical because of the shifting foundation, but Chicago has 60 mi. of electrified freight tunnels under the central business section, connecting the great commercial houses with the railroad freight terminals.

**Education.** As in most large cities, municipal politics have hampered the work of the Chicago public schools, and in 1929-30 the empty treasury brought hardships to teachers and schools alike. In the main, however, the organization and equipment of the elementary and secondary schools are excellent. Free evening and vocational schools and schools for the blind are maintained in addition to the conventional courses for students. In 1929 the public school enrollment was 537,465, for which the city provided 13,119 teachers in 24 high schools, 14 junior high schools and 306 grade schools. Higher education is provided by the University of Chicago, Northwestern University, Loyola University, De Paul University and Lewis and Armour institutes, the latter two polytechnic schools. Included among the important cultural activities of Chicago are the Civic Opera Company, the Art Institute, which offers a variety of courses to students, and the Chicago Symphony Orchestra.

**Streets and Buildings.** The comparatively modern origins of Chicago have made possible a systematic arrangement of streets, not excelled by any metropolis in the world. Millions of dollars have been spent on city-planning projects. In the main, the city is divided by streets running north and south, east and west. The core of Chicago is the "Loop," so called because of the elevated structure encircling the business and shopping district between the lake, the Chicago River and its south branch. In this section State Street, a wide thoroughfare running north and south through the Loop, is flanked by department stores. Running parallel is La Salle Street, the "Wall Street" of Chicago. Michigan Avenue, one of Chicago's main north-south thoroughfares, is flanked in the business section by tall hotels and office structures on the west side; and by the attractive Grant Park on the east side. Much of the 303 acres comprising Chicago's extensive "front yard" has been reclaimed from the lake. The two-level Wacker Drive along the south bank of the Chicago River was completed in 1925 at a cost of \$28,000,000. The South Side is traversed by long straight avenues, among them Drexel and Grand boulevards, cut by numbered streets. Drives lead to Jackson Park on the lake shore of the South Side, to the Midway flanked by the buildings of the University of Chicago and to Washington Park. Lake Shore Drive on the North Side is lined by palatial residences and leads to Lincoln Park. The north and south main thoroughfares of the West Side are Western, Ashland, Halstead and Racine avenues, connected by drives with Humboldt and Garfield parks.

Despite the clay and sand foundation, skyscrapers have been erected in Chicago, some of them resting on concrete and wooden piles driven from 50 to 100 ft. beneath the surface where bedrock is sometimes encountered. Noteworthy tall buildings in the Loop and North Michigan Avenue districts are the Tribune Tower, 462 ft., Chicago Temple, an office structure topped by a church spire, 569 ft., Pure Oil Bldg., 543 ft., the Wrigley Bldg., 210 ft., the Morrison Hotel,

635 ft., and the Mather Tower, 519 ft. Other buildings noted for their style are the Public Library, the Chicago Art Institute, the University of Chicago buildings, the Federal Building, the Palm Olive Building on Michigan Boulevard and the Field Museum, in white marble of Ionic style completed in 1920, in Grant Park. The Chicago *Daily News* Building and Chicago Civic Opera Building are notable modern structures. The old Field Museum has now been entirely restored by funds raised by a bond issue. The building is to be the permanent home of the Industrial Museum, founded by Julius Rosenwald. Grant Park is the site of Soldiers' Field, a stadium seating 145,000. Chicago also has the first planetarium built in the United States, the gift of Felix Adler, occupying a plot of land filled in on the lake front.

**Parks and Monuments.** In 1930 Chicago had a total park area of 5,912 acres, while projects underway promised to increase this acreage materially. The "Chicago Plan" proposes eventually to make the entire lake front a line of parks, interrupted only by necessary port facilities. Chief among Chicago's parks are Grant Park, 303 acres, Jackson Park, 553 acres on the lake shore of the South Side, Washington Park, 371 acres, Lincoln Park, 881 acres, Humboldt Park, 205 acres and Garfield Park, 187 acres. In Grant Park is the Buckingham Memorial Fountain. The celebrated *Fountain of Time* by Lorado Taft was erected on the Midway in 1922. The city is rich in statues of Lincoln and other American notables (see GRANT MONUMENT), and in monuments commemorating the early history of Chicago.

**History.** Indians used the Chicago River as a water and portage route from the Great Lakes to the Mississippi. The first white men to find their way to its mouth were Joliet and Marquette, in 1673, and shortly afterward the French built a fort at the Chicago portage. In 1777 a Negro set up a trading station, which in 1803 was sold to John Kinzie, first American settler on the site of the future city. The Indians ceded the site to the Federal Government in 1795, but Ft. Dearborn, as the stockade and garrison were called, did not begin to grow noticeably until 1830, when the government undertook construction of the Illinois and Michigan Canal. Three years later a harbor was built, and in 1837 Chicago incorporated as a city with a population of 4,170. In 1852 the city was reached by the Michigan Central Railway, and its growth was quickened. The Great Fire of 1871, which destroyed 2,024 acres at a cost of \$187,000,000, did not destroy the expectations of Chicago, which was rebuilt in two years. The Colombian Exposition of 1892-93, or World's Fair, advertised Chicago to all nations. The enthusiastic movement for civil improvement in all directions began in the late 90's, when citizens organized the Civic Federation, Municipal Voters' League and similar groups. The population in 1890 was 1,099,850; in 1910 it had grown to 2,185,283. By 1929 plans were well under way for "A Century of Progress,—Chicago's 1933 World's Fair" (official title).

**CHICAGO, UNIVERSITY OF**, a privately endowed, coeducational university at Chicago, Ill. It was founded in 1892 to replace the earlier University of Chicago, founded in 1857 and closed in 1886. Funds for the new institution were supplied by Baptists throughout the country and by contributions from wealthy men, notably by a gift of \$600,000 made by JOHN D. ROCKEFELLER, who is considered the founder. The first president of the university was the noted Hebraist, Dr. WILLIAM RAINEY HARPER (1856-1906). Though non-sectarian, the university has a charter providing that three-fifths of its 30 trustees shall be Baptists.

The present university is made up of an undergraduate school, a graduate school of arts, letters and sciences, and the following professional schools: Divinity School, School of Commerce and Administration, School of Education, Graduate Library School, and a School of Social Service Administration. It is significant that of all the degrees granted nearly 10% have been Ph.D.'s. The university utilizes the summer session by dividing the academic year into quarters of 12 weeks each, and courses are arranged, according to groups, in majors and minors. Of special importance has been the growth of the university's medical equipment. Rush Medical College, affiliated with the university since 1898, was made an integral unit in 1924, and for this department splendid new clinics and hospitals have been erected. The Yerkes Observatory is situated at Lake Geneva, 65 miles from Chicago. The university is rich in museums and laboratories, and its libraries now have a total of about 940,000 books. The University of Chicago was the first in the United States to organize a university press. Endowments and gifts to the university have been extremely liberal, those of John D. Rockefeller alone amounting to about \$35,000,000. The productive funds of the institution in 1931 were \$59,929,899. The total number of students enrolled in 1930-31 was 13,646, of whom approximately half were graduate students. The faculty of 623 members was headed by Pres. ROBERT M. HUTCHINS.

**CHICAGO HEIGHTS**, a city of Cook Co., Ill., 27 mi. south of Chicago. The original settlement, called Thorn Grove, was made in 1833 at the intersection of the Old Sauk and the Old Vincennes trails, both intimately connected with the development of the West. The Lincoln and Dixie highways now intersect at Chicago Heights, "the crossroads of the nation." Numerous railroads and Ford Lansing Airport, 7 mi. to the northeast, serve the city. Iron, steel and clay products are the leading manufactures. In 1929 the value of the factory output was about \$44,000,000; the retail trade amounted to \$11,784,139. The district is rich in Indian lore and comprises 1,200 acres of forest preserve. Thorn Grove became the village of Bloom and eventually the city of Chicago Heights and was incorporated in 1892. Pop. 1920, 19,653; 1930, 22,321.

**CHICALOTE** (*Argemone platyceras*), called also prickly poppy, an intensely spiny annual of the POPPY family, with large handsome white, purple or rose-

colored flowers, frequently cultivated as an ornamental. The plant, which grows from 1 to 4 ft. high, with stiff branches and a thickish yellow juice, is found wild in dry soils from Texas to California and South America.

**CHICHESTER**, a municipal borough and cathedral city of Sussex, England, in the coastal plain bordering the South Downs, 69 mi. southwest of London, and one mile from Chichester Harbor. Important as *Regnum* in Roman times, it became commercially prominent during the Saxon and medieval eras. The streets and well-preserved city walls follow Roman planning, and noteworthy besides the cathedral are the ornate, Perpendicular market cross; 12th century St. Mary's Hospital; St. Olave's Church incorporating Roman material; and the 13th century guildhall where William Blake in 1804 was tried for sedition. Situated some 4 mi. north of celebrated Goodwood Park, modern Chichester boasts many hotels catering to the race-course visitors. It also has a considerable agricultural trade, particularly in cattle, and a heavy traffic with Chichester Harbor by canal connection. Pop. 1921, 12,413; 1931, 13,911.

**CHICHESTER CATHEDRAL**, Chichester, England, one of the smallest cathedrals in England, representing almost every stage in the development of English architecture from 1091 until the Reformation. It has been called the epitome of English church architecture for the 11th, 12th and 13th centuries. Completed in 1108, it burned down in 1114 and was rebuilt chiefly in the transitional Norman style. In 1186 another fire destroyed the wooden roof and damaged the clerestory. The nave, choir and transepts were vaulted when the damage was repaired and new buttresses were added. Between 1199 and 1210 the east end was extended to form a handsome choir with particularly fine marble piers. During the 13th century chapels were built along the sides of the nave, a feature common in French cathedrals, but not seen elsewhere in England. Later these chapels one each side were thrown into one, thus forming outer aisles. An addition was built to the lady chapel, and the interior of the cathedral was somewhat remodeled by Bishop Gilbert between 1288 and 1305. The spire was added between 1369 and 1385. In the 15th century the detached campanile, unique in England, was erected. The spire and tower were rebuilt and the lady chapel was restored in the 19th century.

**CHICKADEE**, the name given in North America to certain species of titmice (*Penthestes*), small plain-colored birds with active, restless habits. The black-capped chickadee (*P. atricapillus*), the best-known species, ranges throughout eastern North America north of northern New Jersey, generally frequenting wooded country but flocking around human habitations in winter. It is about the size of a house wren, ashy gray above and whitish below, with the crown, nape and throat shining black and cheeks white. The chickadee feeds chiefly on seeds and injurious insects, and nests in a hollow in a stump or in a bird house, laying 5 to 8 brownish-spotted, white eggs. Its usual note is a clear, cheery "chick-a-dee," but in the spring

it whistles a clear "phe-be" or "phe-be-be" much more distinctly than the real phoebe bird.

**CHICKAHOMINY**, an Algonkian-speaking tribe belonging to the Powhatan confederacy and dwelling formerly on the Chickahominy River in Virginia. In the 17th century it was the most important native group in Virginia, having allied itself with the English, but by the following century the Chickahominy had dwindled to less than 100. They have since then lost their tribal identity, but a mixed-blood group living in the aboriginal habitat still retains the name, though having no regular tribal organization. This group is allied with the Pamunkey and Mattaponi.

**CHICKAMAUGA, BATTLE OF**, Sept. 19-20, 1863, an indecisive, sanguinary engagement of the CIVIL WAR. Along Chickamauga Creek, near Chattanooga, Gen. Rosecrans with about 57,000 Union troops confronted the Confederate army of 71,000 under Gen. Bragg. Bragg's objective was to force his way through the Union line to Chattanooga. The brunt of his attack was directed upon the Federal left wing, under Gen. Thomas, guarding the desired highway. While Gen. Walker engaged Thomas, Gen. Hood attacked the Federal Gen. Crittenden, center; on the opposite wing Gen. Buckner attacked the Federal Gen. McCook. The first day's fighting was indecisive. Overnight Rosecrans concentrated his troops to strengthen Thomas's position, and Bragg redivided his army into two commands, under Gen. Polk on the right and Gen. Longstreet on the left. While Thomas repulsed the Confederate charge with great losses, McCook gave way before Longstreet. Longstreet, shifting his forces to assist Polk against Thomas, made no headway in a battle lasting until dawn. The Confederate loss was 17,000 men; the Union loss, about 16,000. By Sept. 22 the entire Union army, reunited, was posted for the defense of Chattanooga. See CHATTANOOGA, BATTLE OF.

**CHICKASAW**, one of the present-day Five Civilized Tribes of Oklahoma, an important Muskogean-speaking warlike tribe which lived, in the 18th century, in northern Mississippi, though they claimed additional territory beyond the limits of their villages as far as the confluence of the Ohio and Tennessee rivers. Their language served as a means of tribal intercourse for all the peoples of the lower Mississippi. They were organized in two phratries consisting of six gentes each.

**CHICKASHA**, a city in southern Oklahoma, the county seat of Grady Co., situated on the Washita River, 38 mi. southwest of Oklahoma City. Bus lines and three railroads serve the city. The Chickasha Municipal Airport is located south of the city. The region produces chiefly cotton and grain. Lumber, cotton, cotton seed and flour are among the principal local manufactures. In 1929 the factory output was valued approximately at \$4,000,000; the retail trade amounted to \$8,958,041. Chickasha was founded in 1892 and incorporated in 1893. The Oklahoma College for Women, founded in 1911, is located here. Pop. 1920, 10,179; 1930, 14,099.









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